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The New Year.

THE majority of our readers will receive the present number of the ELECTRICAL REVIEW on the first morning of the New Year, and we avail ourselves of this timely and appropriate moment for greeting all of our supporters, and all whom we endeavour to serve, with a very cordial and confident wish that they may have happiness and prosperity from January to December in 1926.

We do not say this purely because it is the custom for good wishes to be on everybody's lips on New Year morning—in the past there have been times when the prevailing and threatening conditions have heavily beclouded the situation and prospect so that any such wish seemed to be little more than father to the thought. To-day, we believe, notwithstanding the difficulties that are known to lie ahead of us in settling some of our serious industrial problems, that there are signs that justify greater optimism than could safely be entertained at any other time during the last few years.

The official analysis of unemployment returns reveals encouraging information regarding the industrial "spots" where changes for the better have lately been taking place, and it cannot fail to be of assistance in dealing with this serious problem to know just where and why things have been getting worse. It narrows down the questions for discussion and clears the pathway to betterment. It is of practical value to other branches of industry to know that the Ministry of Labour finds that, apart from the crisis in the coal industry, the figures appear to indicate that the general improvement in employment experienced in 1924 continued during 1925. In the engineering industries—which have been up against exceptional difficulties for a long while—there has been a distinct improvement in employment. As an indication of the general trend of things, it is noteworthy that, while the year's increase in unemployment in mining was 116,878 workers, the total number of insured

persons unemployed increased by only 55,178. The improvement of the last month or two affords further encouragement, but from the standpoint of national engineering industry, the fly in the ointment consists in the reduction of men engaged in engineering industry by their transfer to other trades or their departure to lands where their class of work has presented better opportunities than they could find in this, the Birthplace of Engineering.

If we turn from the general to the particular, and limit our thought to the outlook for the electrical engineering industry and trade, we have every reason to be optimistic, for there appears to be abundant work in prospect in every section—plant, switchgear, &c., for power stations and industrial works, cables for electricity supply, telegraph and telephone development, overhead and underground lines, radio apparatus, appliances and fittings for domestic electric service, and indeed in the whole range of things comprised in the term "Everything Electrical."

If we pull "all together" enthusiastically, and are unafraid and full of initiative in enterprisingly launching out upon the development of departments of electrical activity in which there is unmistakable scope —such, for example, as domestic electricity and railway electrification—we shall be able to give employment to thousands more employés, and strengthen still further the position of British electrical industry. We might write much on the need for the spirit of Locarno to permeate our ranks—employers, staff, and workpeople—but the mere mention of that spirit will suffice at the moment. Another point which also presses in upon one's thought as one looks forward is the need that exists for us to continue to hang together in the support of British electrical industry, for there are many who fear that as the Continental situation improves under the influence of the great achievement at Locarno, the menace of foreign electrical competition will become much more serious.

Combustion Engineers in Power Stations.

THE correspondence on this subject which has appeared in our pages, together with the article by Mr. C. F. Wade which we published last week, should do good service in directing attention to the importance of this branch of central-station practice. It may no doubt be a platitude, but it is true, that the greatest scope for economy in the generation of electricity is to be found in the operation of the boiler house. The boilers, turbines, condensers, and other plant are the tools with which the station engineer manufactures electricity—once installed, they cannot be materially altered in design; but they may be used efficiently or inefficiently, and the financial results of the working of the plant depend mainly upon the ability of the engineers who are directly responsible for their operation. Certain economies can be effected in the engine room, but it is in the boiler house that skill and knowledge have the greatest opportunity. In emphasising this fact, we have no thought of "belittling" the status of the engineer in charge of the engine room, who bears a heavy responsibility.

We are pleased to note that the views of the Electrical Power Engineers' Association, as embodied in the editorial columns of the current issue of its journal, *The Electrical Power Engineer*, are in harmony with our own. Referring to the recent correspondence, our contemporary agrees "that there still appears to be a deplorable lack of appreciation of the importance of the work that a technically-trained combustion engineer may carry out in the boiler house," and proceeds to take the Southampton Corporation to task for offering a salary of less than £300 a year for a fully-qualified man, pointing out that to satisfy the specified requirements an applicant must not only have had a good technical training, but also must have held a responsible position in a large power station where it was the practice to make tests both of fuel and of boilers. "Usually a man fitted for the vacancy must have held at least a charge engineer's position." The journal points out that such poor salaries will deter engineers from qualifying themselves for these important positions, and that "it is not likely that a man will spend time, energy, and money equipping himself with special qualifications if the inducement to do so is so unsatisfactory." The *Electrical Power Engineer* therefore regards the competent combustion engineer as an adequately trained and experienced charge engineer who has added to his attainments further special qualifications, and rightly claims that in order to secure the economies that such a man can bring about in the boiler house, electricity supply authorities must be prepared to offer him a fair rate of remuneration.

A Washer not "All-Electric."

IN our "Correspondence" columns to-day we are reproached for publishing a description of a new electric washer because it is provided with a gas burner for heating the water. Surely the ease with which an electric immersion heater can be substituted for the gas burner is so obvious that the objection is trivial. The design of the washer *qua* washer presented so much novelty that we would not let the one patent defect of the device condemn the whole to obscurity. Moreover, if the small motor—the most expensive single item in the construction, and the only part which interests the electrical manufacturing industry—does not justify the description of this washer in an electrical journal, then *no* electric washer is entitled to appear in our pages; for the other machines, as our correspondent implies, have no provision for heating at all, and have only the motor to justify their inclusion.

With regard to that question of heating, we have heard strong objection raised to the ordinary electric washer by a practical housewife on the ground that she would have to retain the "copper" to heat water for the washer. The suggestion implied in the last paragraph of our correspondent's letter (that washing machines do not require heating arrangements) savours of the "what-was-good-enough-for-father-is-good-enough-for-me" idea; and in the many large areas where electricity for heating water is still charged for at over 2d. per kWh, there is quite a good reason why the heating medium should not be electricity. The part-electric house came along before the "all-electric" home, and every step towards lightening domestic labour, improving the day load, and giving employment to electrical workpeople is, in our opinion, a step towards a higher plane of comfort and prosperity.

French Industrial Progress.

THE report of Mr. J. R. Cahill, British Commercial Counsellor at Paris, which we review in this issue, records a continuance of the prosperity which the French electrical industry has enjoyed since the war. All over the world the extension of the use of electricity is proceeding, but it is probably true that France is in the van of progress in seeking to make up her severe war losses by its aid.

Summing up the present position of France, Mr. Cahill says that she has considerably reinforced her permanent capacity as a producer of raw materials; she is acquiring a wider and more penetrating hold upon her home market; and by virtue of her improved equipment, her larger-scale production, the combination and consolidation of her great industries, and her enhanced comprehension of foreign trade methods, she possesses now greater industrial capacity, skill and competitive power as regards foreign trade.

Electric Panel Heating.

A Brief Description of the Most Recent Installation.

By R. M. BUSSY.

DUE perhaps to the fact that "electric panel heating" has, until recently, been confined to private houses and establishments, few people seem to be familiar with it. It has, therefore, been a surprise to many to hear of the remarkable results that have been obtained from the most recent installation, which is the first of its kind in a public theatre, namely, the Cinema de Paris, in Leicester Square, London. It is proposed to give here a few details, to acquaint readers with the principles of this system, with special reference to the installation mentioned.

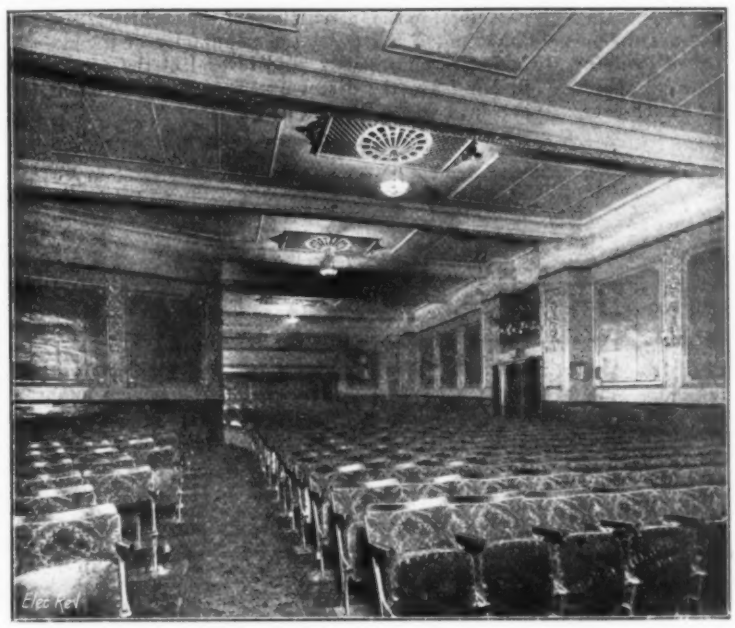


Fig. 1.—Cinema de Paris Auditorium, showing Ceiling Panel Heaters.

So far as has been possible standard size, or "unit," panels have been utilised throughout the theatre, being 6 ft. by 3 ft. by 1½ in., fixed on the surface of the ceiling and finished with suitable moulding so that they follow the general lines of decoration. Although this method was adopted in this case to save time in erection (the theatre was not closed during the whole of the work), it is more usual to bury or form the panels in the ceiling, thus giving a smooth ceiling surface. There are thirty-four standard panels on the auditorium ceiling, fig. 1, and two in the corridor from the Charing Cross Road entrance. Further, three panels are fixed in the Charing Cross Road (two) and Bear Street (one) entrance lobbies, which have been specially shaped and have their sides parallel with the adjoining walls. Every panel is fixed with six ¼-in. bolts, two passing right through the roof and four being ragged into it.

The conduit used is of the heavy gauge screwed class, and is embedded under the cornice on each side of the auditorium. Square boxes, 4 in. by 4 in. by 2 in. deep, are fixed in the centres of each bay, and tubing from the panels is bent down behind the cornices and into the boxes. In this way all the wiring is confined to the two chases, while the square boxes (with their lids flush with the wall) allow ample openings for handling, should it be necessary in the future. The panels are wired in pairs, each pair having a separate switch and pair of fuses.

The switchroom is situated by the side of the projection room at the end of the theatre, fig. 2. The gear consists of a main 150-ampere ironclad switch and fuses surmounted by a connector box, on each side of which is a ten-way ironclad fuse board. The central connector box provides ironclad protection for the extended busbars, the connections from the main switch, and also the shunt for an ammeter, reference to which will be made later. Under each fuseboard is a cast-iron box having a teak front panel on which are mounted ten rotary switches.

The ammeter is of the long-scale type divided in such a way as to show a definite movement as each circuit is energised. This enables the operator to see at a glance whether each circuit is in perfect order when he manipulates its switch. The whole of the switchgear is mounted on a metal frame and efficiently earthed.

The method of switching that has been adopted gives a control of 17 variations, not only of radiant heat emitted, but also of location of the panels emitting. The heat control enables the auditorium temperature of 55 deg. F. to be maintained constantly, while the control of the panels from the point of view of location enables variations of wall absorption, due to variations of wind, &c., to be counteracted.

It is due to this perfect control that the consumption of electrical energy is so low. In the extreme case of a prolonged outside temperature of 30 deg. F., only 23 kWh per hour are required to maintain a temperature of 55 deg. F. in the whole of the theatre when it is empty; when the outside temperature is about 42 deg. F., not more than 15 kWh an hour are required. These

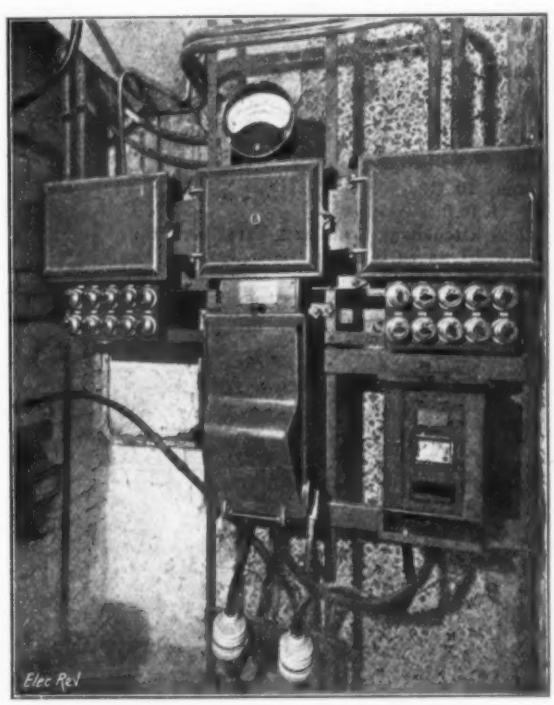


Fig. 2.—Switch Room for Panel Heating.

figures are based on the assumption that there is no audience present and, therefore, are higher than is generally found necessary in practice.

At the Cinema de Paris, the unanimous opinion of the management is that the heating bill for entertaining over four hundred patrons at each performance is lower than it would be with any other system. Further, it must be remembered that only radiant heat is used, the panel temperature being too low for convection currents, even were this possible with the panels fixed to the ceiling. It is the freshness and coolness of the atmosphere which first strikes the visitor so pleasantly upon entering the building.

With regard to maintenance cost, it must be remembered that not only is the price of electricity for heating very low, but in many cases special prices are quoted by the electricity supply authorities for such loads as these. Moreover, the control requires no special operator. A simple chart has been hung on the switch-room wall, and on it the panels are indicated and numbered, the numbers referring to the switches by which they are operated. Obviously, all that has to be done is to look at the chart for the reference numbers of the panels that are to be put into use and then to turn the corresponding rotary switches. No special knowledge at all is required.

It should be added that only after a long trial of gas-steam radiators, was the decision made to change over to an electrical installation. The panel system was chosen rather than that of electric radiators, on account of the increased seating space which became available when the source of heat was removed entirely from the floor.

Since the completion of this installation, which was carried out entirely by Messrs. Grierson, Ltd., the patentees, to the instructions of the architect, Mr. Robert Atkinson, F.R.I.B.A., the popularity of the system has increased enormously, and several of the contracts now in hand are the direct outcome of the excellent results obtained at the Cinema de Paris.

An All-Electric Experiment.

Some Particulars of Cottages Recently Erected near Birmingham.

AN experiment of considerable interest is being carried out at Birmingham, where the Woodlands Housing Society, Ltd., has recently erected two cottages equipped with apparatus for lighting, heating and cooking by means of electricity. The cottages, fig. 1, have been built to a compact design by the Society's architect, Mr. S. A. Wilmott, special thought being given to the questions of comfort and convenience to the householders. Each dwelling comprises a large front sitting room, 16 ft. 5 in. by 11 ft., a combined kitchen and scullery, three bedrooms, and a bathroom. One cottage is "all-electric," while the other one has one coal range to warm the kitchen and heat the hot-water system.

Fig. 1.—All-Electric Houses.

The sitting room, fig. 2, of the "all-electric" cottage is lighted by means of a 100-W gasfilled lamp in an Italian alabaster bowl fitting, a plug being provided for a reading lamp. The room is heated by a 3-heat 3-kW radiator, a three-way adapter plug being installed to accommodate any other apparatus such as a vacuum-cleaner, kettle, toaster, &c.

The lighting equipment in the kitchen-scullery, fig. 3, consists of an enclosed-globe ceiling-type kitchen fitting with a 60-W gas-filled lamp. A modern electric cooker is supplied on hire by the City of Birmingham Electric Supply Department. A supply of hot water can be instantly obtained from a 3-kW Santon geyser, and a 3-kW wash boiler is also installed. A 3-heat 3-kW Utility fire,

Fig. 2.—Sitting Room.

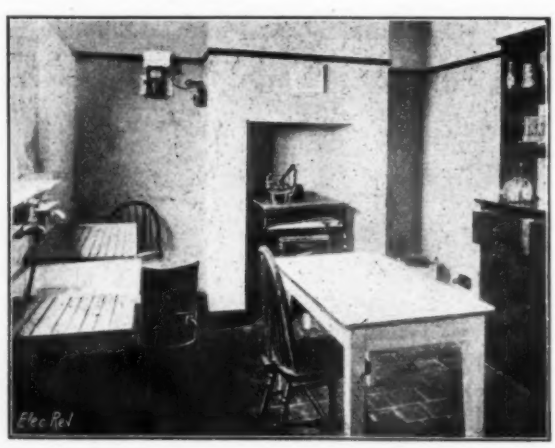


Fig. 3.—Kitchen-scullery.

equipped with a hot plate, supplies the necessary heating to this apartment.

Two lighting fittings, with 60-W lamps, serve the large bedroom, which is heated by a 2-kW electric fire. The other bedrooms each have one lighting point, and a wall plug is provided for a radiator. Two fittings provide for the lighting of the hall and the landing. A hot-water storage tank is installed in the bathroom and in the circuit for this and that of the wash boiler, pilot lamps are provided.

Ample allowance for extensions has been made in the wiring, which is run in screwed tubing.

In order that builders, architects, and all interested in the housing problem might have an opportunity of seeing the cottages, they were open for public inspection during the week commencing December 14th, when members of the staff of the City Electricity Department, which is naturally supporting the Housing Society in its experiment, were daily in attendance to give information. During the week additional apparatus, consisting of an electric sewing machine, vacuum-cleaners, toasters, irons, and other labour-saving appliances, were installed, and a cookery demonstration was given each afternoon by the department's lady demonstrator.

Great credit is due to the Woodlands Housing Society for its progressive move, which, we believe, is the first of its kind to be undertaken by such a society, and which should prove an encouragement to similar concerns and to private builders; the result of the trial will be awaited with interest by many who are interested in the housing problem.

The purchase price of the "all-electric" house, complete with the apparatus, on leasehold for 99 years, is £500, and Mr. Dean, the secretary of the Society, who has all along enthusiastically supported the experiment, states that this house has already been sold. The gardens of both cottages have been tastefully laid out by the Bournville Village Trust.

Large v. Small Generating Stations.

A Comparison of Coal Consumptions.

(COMMUNICATED.)

ACCORDING to statistics prepared by the Electricity Commissioners nearly sevenpence out of every shilling spent on the generation of electricity in Great Britain is required to pay the coal bill. That the cost of fuel usually outweighs all the other expenses of running a power plant put together is generally recognised among central station engineers, and a healthy rivalry exists in the reduction of this preponderating item of the generating costs. While, however, the cost of fuel per unit generated is a satisfactory measure of efficiency for the accountant, it is not so fair from the technical point of view. The figure varies exactly in proportion to the price per ton at which coal can be purchased, so that the engineer whose plant is unfavourably situated with regard to coal supplies is under a heavy handicap when costs alone are considered. The real technical criterion of performance is, of course, the thermal efficiency of the station, but so great is the difficulty of determining the true average calorific value of the fuel burnt—to say nothing of the impossibility of getting other engineers to believe that it has been accurately determined—that the Commissioners, wisely, we think, have disregarded thermal efficiencies in their recent "Return of Engineering and Financial Statistics." They give, instead, merely the pounds of coal per kWh generated, leaving the reader, from his knowledge of power station matters in general, to make what assumptions he likes as to the calorific value, and therefore as to the thermal efficiency in any case. Should a station be burning "duff" or other low-grade coal the pounds of fuel burned per kWh may appear high, but reference to the tables of costs will indicate whether the performance is justified by its financial results.

Unfortunately, no method of comparison can be fair to all stations. Costs, as we have seen, have no necessary correlation with technical efficiencies. The latter, again cannot be fairly appraised by merely regarding the quantity of fuel burnt per unit generated, as this figure will depend not only on the quality of the fuel, but on the size and nature of the station concerned. With all its defects, however, the simple method of comparing fuel consumptions per unit, without reference to anything else, gives us the best "first approximation" to what we want. Allowances can be made afterwards for disturbing factors. The two things which are known with as much certainty as anything in a power station are the weight of coal burnt in a year and the quantity of electricity produced in the same time. Hence the data for the calculation are fairly reliable. Besides, after all, a pound of coal is a pound of coal, and if one station burns four pounds per kWh while another only requires two pounds, the fact is interesting, and the explanation, if there is a satisfactory one, can generally be found.

Keeping then to this basis of comparison, it is instructive to note how the fuel consumption of different stations varies with their magnitude. The question often arises as to why a comparatively small station, so long as it is large enough to justify the expense of modern equipment, should not be practically as efficient as a station of the largest size. Put in another way, the question becomes: "What is the limit of size, below which a high efficiency is not obtainable?" The matter is not one that can be satisfactorily settled by calculation. A small station may not be able to afford combustion engineers, chemists, and other specialists to supervise operation, but on the other hand every detail can receive the personal attention of the chief, who, if he is a good man, will achieve results that many a more elaborately organised undertaking fails to attain. The best engineers are by no means always to be found in the biggest stations. The salaries which attract good men attract bad ones as well, and neither electricity committees nor boards of directors are infallible in their judgment.

Instead of trying to determine from theoretical considerations how small stations should compare with large ones in the matter of coal consumption, it is much more satisfactory to see how they do actually compare in practice. It is misleading to bring individual plants into contrast because of variations in managerial ability and other features. The only fair comparison is on a statistical basis, taking a large number of stations into consideration so that individual peculiarities may average out. The data collected by the Electricity Commissioners enable this comparison to be made. Particulars are given in their return of the fuel consumption per kilowatt-hour of nearly every power station in Great Britain, whether owned by a company or a municipality. To present the facts in a graphic form, the coal consumption per kilowatt-hour has been plotted in fig. 1 against the annual output for 123 stations having outputs of less than 20 million kilowatt-hours per annum. These are all municipal plants, the company plants being omitted merely in order to keep down the number of points. Disregarding stations using oil fuel partially or wholly, and also those for which the required data were missing, there are tabulated in the Return 153 municipal plants

in England alone. Twenty-nine of these are excluded, as having outputs of over 20 million kilowatt-hours per annum, and one, with an output of about 100,000 kWh, has been omitted because its coal consumption point of 12.8 lb. per kWh fell outside the limit of the chart. The performances of the remaining 123 stations are represented by the points plotted.

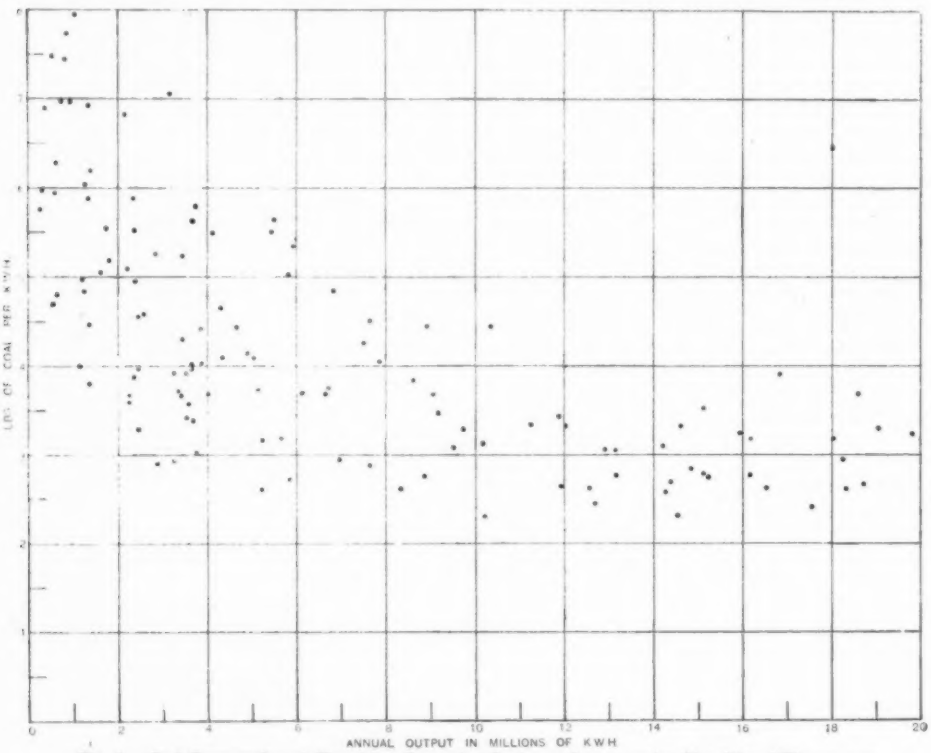


Fig. 1.—Coal Consumption of Electricity Generating Stations; Output, under 20 million kWh per year.

Two things strike one especially when looking at the diagram: first, the relatively large coal consumption of the smaller stations, and, secondly, the extraordinary differences between individual performances. Of the 12 stations having an output of less than a million kilowatt-hours per annum, one required 7.73 lb. of coal and another only 4.69 lb. per kWh. Of the next 13 stations, with outputs between one and two million kilowatt-hours, the fuel consumption ranged from 7.96 lb. to 3.80 lb. per kWh, and so on. In the 5 to 6 million group one station, with an output of 5.517 millions, consumed as much as 5.65 lb. of fuel per kWh, while another produced 5.220 millions for a consumption of only 2.61 lb. The former station we will not mention by name, as the engineer, no doubt, has sufficient trouble already, but the latter, which is that at Nelson, in Lancashire, deserves credit for its performance. The fuel consumption is only beaten by five other stations, all much larger, and only one of the seven plants with outputs over 18 million kilowatt-hours can equal it.

Only four of the 123 stations dealt with could show a fuel consumption of less than 2.5 lb. per kWh, and the best of these, Rawtenstall, also in Lancashire, with a consumption of 2.30 lb. per kWh for an output of 10.199 millions, beat every other station up to the limit of 20 million kWh, at which the diagram ends. It will be also noticed that there is practically no difference between the average performances of stations with outputs ranging from 10 to 20 million kilowatt-hours per annum. From the evidence of the chart, it would appear that a 10-million station would be every bit as economical as a 20-million one. The range might even be extended, for it is very clear that even a 5-million station under good conditions can, in practice, do as well as the average station three or four times as large.

Leaving exceptional cases, however, out of consideration, one could fairly conclude that stations of an output of less than about 10 million kilowatt-hours are unduly heavy on coal consumption, and unless they are likely to grow rapidly to larger dimensions, the justification for their continued existence should be examined. This does not imply that there is any *à priori* case for scrapping them. Circumstances may well be such that the cost of electricity transmitted from a large and economical station a long way off would be greater than that of electricity generated in a small and uneconomical station locally. Every case must be considered on its merits, but if the smaller stations are to survive anywhere but in the remotest country districts, those responsible for their management should see that their performances are brought to within measurable distance of what has been shown to be possible.

We may now turn to the records of the larger undertakings. As these are not only of greater interest on account of their magnitude, but are also fewer in number, all stations having an output of over 20 million kilowatt-hours in Great Britain, whether municipal or company owned, will be considered together. The largest undertakers in the country have, as a rule, more than one generating station, and it is generally

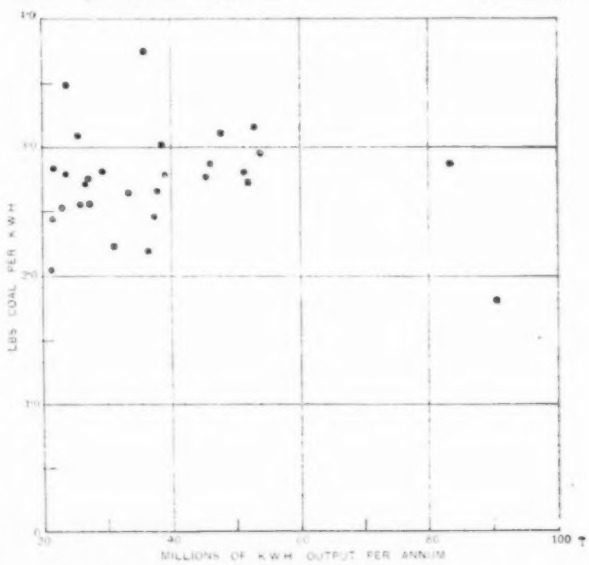


Fig. 2.—Coal Consumption of Generating Plant; Output from 20 to 100 kWh per year.

difficult to determine from the Commissioners' Return the performance of the individual plant. Neglecting for the moment cases of this kind, we have particulars of 28 stations with outputs ranging from 20 to 100 million kilowatt-hours. The performances of these stations are plotted in fig. 2. The great majority, as will be noted, have coal consumptions ranging between 2.5 lb. and 3.0 lb. per kWh. Again we find no sign that a large station is more economical than a smaller one. The record, among the undertakings dealt with, is

certainly held by the wonderfully efficient station of the Lancashire Power Co. at Radcliffe, where Mr. Adams, with steam at only 160-lb. pressure and 520 deg. F. temperature, has reduced his coal consumption to 1.8 lb. per kWh on an output of 90.377 millions per annum. The next best performance of the group is that of Mr. L. L. Robinson at Hackney, with a consumption of 2.04 lb. on an output of 21.464 millions. The unfortunate city which, at the date of the return, required 3.74 lb. of coal per kilowatt-hour to generate an output of nearly 40 million kWh, has now got a new plant in service, and better results may be expected in the next return.

The performances of the undertakings which have been omitted from the diagram, fig. 2, for the reason given above, are tabulated below (see Table I) in the order of economy of coal consumption. Since no particulars are given as to the quality of the coal, the order of thermal efficiency is not necessarily the same as that given in the table, so readers must make what allowances they think fair in comparing the results. It must also be recollected that the Newcastle company's output, for example, is spread over four power stations, varying in size from 17,600 to 78,850 kW capacity of installed plant. Hence the coal consumption of 1.86 lb. per kWh, which is the average over all the four stations, is necessarily inferior to that of the best station of the group, which in the aggregate generates an output of 415.2 million kWh per annum.

In studying the performances which have been brought under review, it must be remembered that the figures are all concerned with periods prior to March, 1923. When the next Return of the Commissioners appears, it is very certain that the relative positions of many of the stations will be changed, and also that an appreciable general improvement in coal consumption will be manifest. Nevertheless, there is no reason to expect that the main conclusion will be different. This seems to be that for all stations with an output of more than ten million kilowatt-hours per annum, the performances will be approximately equal given equal efficiency of management. Below the capacity mentioned, the engineer is handicapped by the general inferiority of his equipment, but the results obtained by some of the small stations where the management is exceptionally good should serve to stimulate other undertakings to greater efficiency.

TABLE I.
COAL CONSUMPTION AND ANNUAL OUTPUT OF VARIOUS ELECTRICITY UNDERTAKINGS.

Name of Undertaking.	Coal lb./kWh.	Output in millions of kWh.
Newcastle E.S. Co., Ltd. ...	1.86	415.2
Glasgow Corporation	1.92	179.0
Manchester Corporation ...	2.04	244.2
Rotherham Corporation ...	2.20	46.9
Liverpool Corporation	2.24	134.4
Sheffield Corporation	2.24	151.5
Dundee Corporation	2.30	31.1
Clyde Valley Power Co. ...	2.35	123.8
Yorkshire Power Co.	2.46	75.8
County of London E.S. Co. ...	2.47	76.3
North Metropolitan E.S. Co. (Brimsdown)	2.65	68.0
North Metropolitan E.S. Co. (Willesden)	2.31	
Mersey Power Co.	2.49	23.3
Cardiff Corporation	2.93	26.1
Wolverhampton Corporation ...	2.95	33.1
Shropshire Power Co.	3.11	49.2
Metropolitan E.S. Co.	3.25	38.7
Edinburgh Corporation ...	3.48	55.1
Birmingham Corporation ...	3.72	156.4
Nottingham Corporation ...	6.15	23.6

The Italian Electrical Industry.

(From Our Special Correspondent in Milan.)

UPON the principle that disappointment is the nurse of wisdom, Italy should soon derive some practical advantage from her somewhat costly experiences in pursuing a vast—and not very well considered—scheme of hydro-electric enterprise. Many millions of capital have been invested and, perhaps, many thrown away owing to the disinclination of Italian engineers—who, as a body, deem themselves inferior to none—to accept suggestion, let alone the offer of practical assistance, outside their own circles. The result of this somewhat unwise policy has been the perpetration of a number of mistakes, some, indeed, of a serious nature—such as defective designs for reservoirs and dams; ill-chosen sites for power-houses; and the selection for exploitation of districts which have subsequently proved subject to drought.

At the time of writing, there are signs that history may possibly repeat itself. Heavy storms have lately passed over the northern districts of Italy; while these have served to replenish the supply dams, the violence of the rains is believed to have undermined more than one of the main structures (built too hurriedly, it is to be feared, and without sufficient consideration having been given to the matter of contours). The terrible Gleno barrage catastrophe which took place at about this time two years ago (December, 1923), when material damage was caused exceeding 100,000,000 lire, has not by any means been forgotten. There are some who declare that the initial errors connected with the building of the Dezzo reservoir, the collapse of which caused the two villages of Teveno and Gueggio to be washed away and many persons to lose their lives, have been repeated in certain other localities. It is to be hoped that eventually this may prove not to have been the case. But the worst feature of this occurrence was that the dam at Lake Gleno had been built and put into use without the permission of the Ministry of Public Works. It is still possible to ignore the Department, and to proceed with public works of this nature without official supervision.

Notwithstanding these facts, the electrical industry of Italy is showing signs of real progress. During the current year the number of central stations has been appreciably increased, and plans are being made for additional stations. An attractive market for electrical machinery, appliances, and fittings is to be found in this country. While the Italians themselves have invested something like 3,000 million lire in the establishment of hydro-electric plant, a not inconsiderable proportion of foreign capital has been employed in the same direction. It is estimated that during the next five years not less than 700,000,000 lire per annum will be expended on new power plant, transmission lines, sub-stations, and other necessary construction.

The Electrical Market.

The opportunities for the sale of electrical goods in Italy are encouraging, notwithstanding the expanding domestic industry, which is constantly developing its home market as well as reaching overseas. Both in quantity and value the total imports in 1925 probably showed a slight decline over the previous twelve months. The principal imports which have come from the United Kingdom and the United States have included several classes of generators and motors, transformers, and various kinds of electrical apparatus. During the first three months of last year generators and motors, weighing 4,121 quintals, and valued at 6,073,303 lire, were imported, as against 3,786 quintals and 3,974,754 lire in 1923, and 4,335 quintals and 5,381,955 lire in 1924. Transformers showed a slight decline in weight, to 1,438 quintals, valued at 1,311,564 lire for the January-March quarter of 1925, compared with 2,085 quintals and 1,993,095 lire in 1923, and 1,229 quintals, valued at 970,967 lire, in 1924. Batteries, magnetos, electric meters, telegraph and telephone apparatus, and

electrical apparatus of various kinds also showed slight reductions either in quantity or in value. While the total imports for the period mentioned actually increased in quantity from 10,340 quintals, in 1924, to 11,100 quintals during the first quarter of last year, the value declined from 25,988,095 to 25,245,770 lire. This is all the more remarkable in view of the fact that the lira has continued to depreciate, the quotation now being nearly 20 per cent. lower during 1925 than in 1924 for sterling and for United States dollars. Regarding exports, which have included all the classes of electrical goods above enumerated, there was an advance over the same period from 4,871 quintals (valued at 7,951,213 lire) in 1923, to 7,407 quintals (valued at 11,103,329 lire) in 1925.

The largest supplier of electrical equipment to Italy has been Germany; Hungary ranked second, the United States third, Great Britain fourth, and France fifth. On the other hand, exports of electric generators and motors from Italy, which showed a decline in quantity from 5,529 quintals for the first three months of 1924, to 4,931 quintals in the first quarter of 1925, were shipped principally to British India (which took 25 per cent. of the total); Brazil and Argentina (which absorbed about 36 per cent.); and Germany, Spain and France (taking between them 17 per cent. and in the order named). The purchases made by Great Britain were small, not exceeding 135 quintals; these figures, however, showed an advance upon the previous year's record, which was 77 quintals, and very much exceeded that of 1923 when the figure amounted to no more than 1 quintal. It is worthy of note that while in the first quarter of 1923 the United States ranked third in the list of countries from which electrical goods were imported by Italy, in 1924 it sank to eighth, and in 1925 it was seventh. During the first ten months of last year, it is estimated, less than three per cent. of Italy's imports of heavy electrical machinery originated in the United States.

Development and Home Production.

Up to recent years, Italy was very largely dependent upon electrical apparatus of foreign manufacture, and, to a certain extent, is still so. None the less, a striking advance has taken place in home production, especially with regard to domestic lighting. This has now been extended to the great majority of the towns and villages of the Kingdom, except to those located in the more inaccessible of the mountainous districts. The use of electricity varies enormously in different sections of the country. In Calabria, for instance, the consumption for lighting *per capita* is only 2.8 kWh, whereas in Piedmont it reaches 26.70 kWh. The average for the entire kingdom is 13.70 kWh. For the current year (1926) the consumption is forecast at not less than 8,000 million kWh, and for 1927 to 1928, some 10,000 million kWh. In 1933, when most of the new stations now under construction, and those for which plant has been made, are completed, the consumption is expected to reach 12,000 million kWh.

Like most European countries, Italy is finding the production and use of electrical appliances of greater and greater importance in connection with the carrying-on of daily life and the conduct of its many industries. The demand for electrical equipment for the home, the office, the shop, the factory, and places of amusement has become insistent, giving rise to the establishment of a number of new factories and retail stores which are being supported and encouraged (by the most favourable taxation) to compete with foreign imports. But the country is still unable to do without resort to a variety of these. Figures of last year's trading in electrical supplies are likely to show little difference in actual value, but in quantity and weight the total may vary considerably from those recorded for the two preceding years.

The annual importation of incandescent lamps now exceeds 11,000,000, a figure which is below that of 1924, and some 2,000,000 under that of 1923. The difference in quantity means that the Italian home manufacture has increased, and is now more fully supplying the ever-increasing local demand. The main source of imported lamps is the Netherlands. To-day, the Dutch have the privilege of furnishing the supplies that formerly came almost entirely from Germany, which held first position among exporting countries. During the first six months of 1925, the Netherlands furnished close upon 3,000,000 lamps, which may be compared with 2,447,109 for the January-June period of 1924, 1,805,022 for 1923, and 2,972,925 for 1922. Germany, which has been under obligation to furnish Italy with lamps under the Reparation Agreement, failed last year to send anything in the way of supplies; but between January and June, 1923, 1,160,000 lamps, mostly of low power and of a decidedly inferior quality, were provided. The ordinary commercial supply of lamps, other than reparations, from the same source, for the period January-June, 1924, was 1,858,351, while during the first six months of last year over 2,000,000 were imported. Austria is another large furnisher of electric lamps, while Hungary and Switzerland send smaller supplies. There is a smaller market for British or American incandescent lamps—notwithstanding their admittedly superior quality—owing to the heavier freight rates involved and the longer distance of transport.

The largest sales—in some districts almost exclusive—are found for metallic filament lamps, with round and pear-shaped bulbs and Edison screw and bayonet bases.

Installation Practice.

Special receptacles, most frequently of the bayonet type, for the attachment of electric toasters, heaters, vacuum-cleaners, and other household appliances, are now installed in most houses. The rotary switch is generally used, but the push-button type is likewise popular. Switches of the snap and tumbler type are practically unknown. On the other hand, American switches are favoured by some Italian electricians, and strenuous efforts are now being made to push their sale by enterprising United States travellers. The fuses most commonly employed are the open link and the German "Z" type. The Edison screw plug takes precedence over both the American cartridge and the British thumb-grip types. The wiring of dwellings is left almost entirely to the discretion of the electrician or the house-owner, little or no control being exercised by the municipal authorities, but the organisation known as the Associazione Elettrotecnica Italiana consents, upon application, to exercise technical supervision over the introduction of new installations. The practice of wiring houses in Italy varies but little from that adopted by other European countries, and the rules governing insulation are only slightly different. Large quantities of twisted cord (a large proportion is imported) are employed, but of a type rather more flexible than the British standard. The most common practice followed in house-wiring is to run the wire or flexible cord on small porcelain knobs, or through thin insulated conduits of the Bergmann type. In houses built during the last twenty years, where the construction of the walls is of brick or cement throughout, this has been found to be the only possible way of introducing electricity. In modern houses, however, a cheap kind of low-grade iron conduit is being used, embedded within the walls or passed through the ceilings.

Water Turbine Testing.—In view of the fact that the rotors of electric generators driven by hydraulic turbines have usually to be designed to withstand for short periods from 1.8 to 2.5 times their normal speed, the Oerlikon Co., of Switzerland, has recently made special provision in its testing department for checking the accuracy of the mechanical calculations and the strength of the materials used in the construction of the machines by over-speed tests. To this end a pit capable of accommodating the largest rotor in a vertical position has recently been constructed; it is about 32 ft. deep and is provided with a thick lining of bags filled with sand as a protection against damage should a rotor burst during test. The pit, which is of a size enabling rotors up to a diameter of 21 ft. and of a weight up to 120 tons to be tested, is surmounted by overhead driving gear comprising two d.c. motors developing together about 1,000 kW at pressures ranging between 250 and 1,500 volts.

Miners' Electric Safety Lamps.

By EDWIN LYON, B.Sc.(Tech.), A.M.I.E.E.

(*Abstract of Paper read before the* BATLEY AND DISTRICT MINING SOCIETY.)

OF the desirable characteristics which a miner's portable electric safety lamp should possess, perhaps the cost of upkeep has been given too much prominence of late. The cutting down of upkeep costs has, in some instances, been taken so far as to reduce the efficiency of the installation. For the sake of a fraction of a penny in the weekly cost per lamp, spares have been cut down to a minimum, at times being foreign parts of doubtful quality, and the installation starved until it is unable to operate efficiently, and an apparent gain becomes an actual loss.

Owing to the heavy service demanded from an accumulator in use underground, it must possess additional characteristics to those needed for ordinary service: Strength is an important feature; accessibility is very desirable, also visibility of the electrodes; repairs should be easily carried out, the attention demanded as little as possible, and not skilled. The lead-acid and the alkaline types differ widely in construction, characteristics, and performance. The most familiar and widely used type is the lead-acid; when used in a miner's lamp special designs are necessary; for example, the grids of the "Ceag" electrode are triangular in section with the apex towards the inner side, to secure the active material safely. Whilst flat electrodes give more active surface area for a given space, circular concentric electrodes are simpler in construction and inherently stronger. The cost of upkeep is greatly increased if the acid is not prevented from leaking or creeping, and the three general methods of approaching the "unspillable" ideal are the provision of tortuous passages for the gases, the "inkbottle" principle, and "jelling" the electrolyte.

In practice gassing chambers require constant attention to prevent them becoming filled with acid, when leakage occurs. The "inkbottle" principle (the provision of space above the electrodes to hold all the electrolyte when the accumulator is reversed, the gassing tube being above the level of the acid in every position) necessitates a larger container, and is effective when kept in good condition. "Jelling" the electrolyte is the nearest approach to the ideal; not only is there no leakage at the inlet or gassing vents, but creeping and leakage at the joints, or minute cracks, are avoided and surprising results have been obtained by the use of "Jellac" (the "Ceag" semi-solid electrolyte). The consumption of spare parts has, in some instances, been cut down to half, and, in addition, the lamp operates much more reliably.

Owing to the higher internal resistance when a "jelled" electrolyte is used, the capacity of the accumulator is slightly reduced, but this is more than balanced by the saving in spare parts and the cleaner and regular operation. Another effect is a more even length of life of the electrodes, the negative having a shorter life than when free acid is used. Both electrodes are generally changed at the end of 12-15 months' service, this period being a fair average. With free acid the positive and negative electrodes are changed at different times owing to the irregular life and the maintenance is not so simple as in the other case, for the free-acid accumulator must be closely watched and topped up to compensate for the escaped acid, but the attention required by the "jelled" accumulator is regular and pre-determined; this means that a simple routine can be followed and the work systematised and simplified.

Another type for which rather startling claims have been made is the alkaline accumulator, which is inherently much stronger than the lead cell, owing to the steel electrodes and container, which also enable it to stand short-circuits and rapid charge and discharge. For many duties these features are desirable, but for lighting a miner's lamp they are of little value, as short circuits very rarely occur, and the rate of discharge and charge does not vary. The voltage of each cell is 1.3, so that the usual standard unit is composed of two cells and the voltage of the battery is therefore 2.6 volts. The discharge curve is comparatively steep, particularly at the commencement, with the result that when used in a miner's lamp the bulb is working at a higher voltage at the beginning of the shift. This means that the bulb is over-run at the first stage, or is not operating efficiently over the greater portion of the discharge, see fig. 1. The watt-hour efficiency is much lower than that of the lead-acid accumulator; although this, in itself, is not an important factor as the cost of current is rarely considered, it has an effect on the initial cost of the charging equipment. Owing to the high internal resistance the final voltage of the battery when on charge is nearly 3.6 volts, so that on a 110-volt circuit only thirty alkaline cells can be charged in series, whereas the same equipment would be suitable for forty of the lead-acid type. The initial cost of the battery is also high, being approximately three times that of the other type.

The bulb is the next component of fundamental importance. The bow-shaped filament seems to be now universally adopted as the simplest and strongest design. The modern bulb is a reliable and efficient component; there is, however, one important factor that might well be considered, and that is the relation between the watts per candle and the length of life. The higher the watts per candle, the longer the life; in other words, the higher the illuminating efficiency the shorter the life, and the most serviceable bulb is a compromise between these factors. A bulb working at about 1.9 watts per c.p. has an average life of 500 burning hours, and this is the usual rating. Another interesting relation is that between the applied voltage and the candle power of a bulb. Fig. 2 shows that for an increase in voltage the increase in candle power is more than correspondingly great. It follows that the c.p.-time curve is an exaggerated copy of the discharge curve, showing the importance of an even discharge voltage.

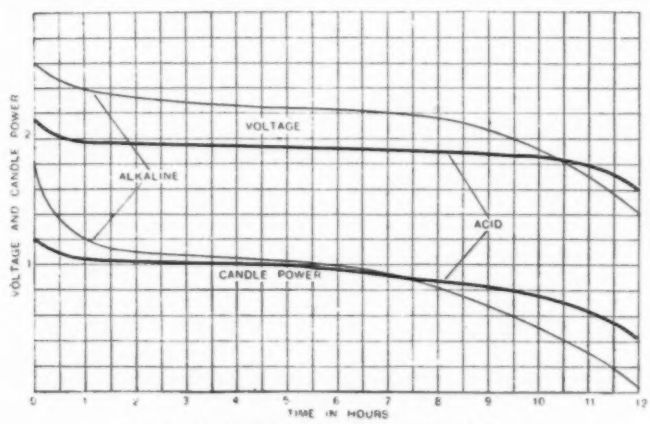


Fig. 1.—Discharge Curves of Miners' Electric Lamps; equal size, and bulbs of same efficiency.

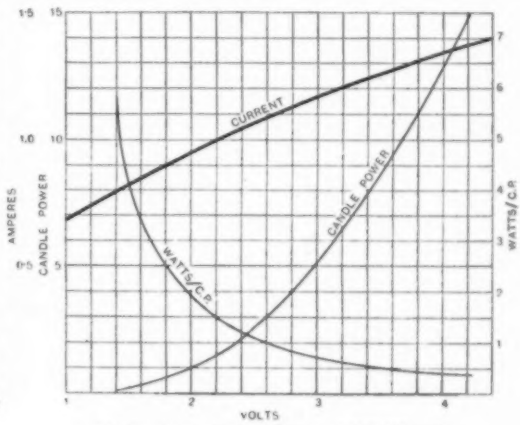


Fig. 2.—Characteristic Curves of 2-V Miners' Lamp Bulb.

There are two alternative methods of securing the lamp parts together: the Oldham lamp is a typical example of machine-operated screw-thread joints, and the "Ceag" lamp an example of the application of the bayonet joint. An interesting speed joint is the "Ceag" ratchet retaining ring: To remove the wellglass and bulb the ring is given a quarter turn with a small hand key and the fittings are available without further dismantling. A recent development in the direction of quick operation of components is the Oldham "snap-on" lid, which enables the electrodes to be taken out and the cell case cleaned out in a very short space of time, as the lid is removed by a simple machine. The lid carries an annular ring with a groove in the periphery, and when pressed on to the case, expands it past the edge of the ring when it closes into the groove; a rubber ring in the groove makes a leak-proof seal.

The "Ceag" quick-action lid operates on a different principle: Three lugs on the lid are so designed that by pressing the lid on the case they drop into internal slots, definitely locating and retaining the lid in position. The accumulator is made unspillable by the provision of a groove in the lid which holds a special composition. As the case fits into the groove a light leak-proof joint is made, although, as "Jellac" is used, this is not essential. When the lid is given a twist, the lugs disengage and allow the removal of the electrodes whilst still on the lid. It is not necessary to remove the contact nuts, so that the time needed for dismantling is reduced to the minimum.

One of the chief advantages of an accumulator which can be rapidly dismantled is that there is more encouragement for the lampman to give it regular periodic attention. This is most important; if inspection and cleaning can be performed without much trouble there is more probability of it being done

at the correct time. Particularly in the case of "jelled" electrolyte, topping up should take place at least every fortnight, and attention given to this will lengthen the time before cleaning out is necessary and keep the accumulator in a healthier condition. Differences between the upkeep costs of installations using the same type of lamp are often attributable to lack of attention to these points.

In the two-piece lamp, the accumulator is made an integral part of the bottom case. This reduces the number of parts to be handled to two, but any advantages due to the increased speed in handling must be weighed against the disadvantages of not being able to see the condition of the accumulator, corrosion of the bottom casing, and the fact that spare accumulators alone can not be carried. One method of making an ordinary lamp into a "two-piece" lamp is to fasten the accumulator into the case with paraffin wax, which has been adopted in the Bruay mines in France, where it has apparently proved successful. As a semi-solid electrolyte is used, there is no trouble from leakage and less attention is required.

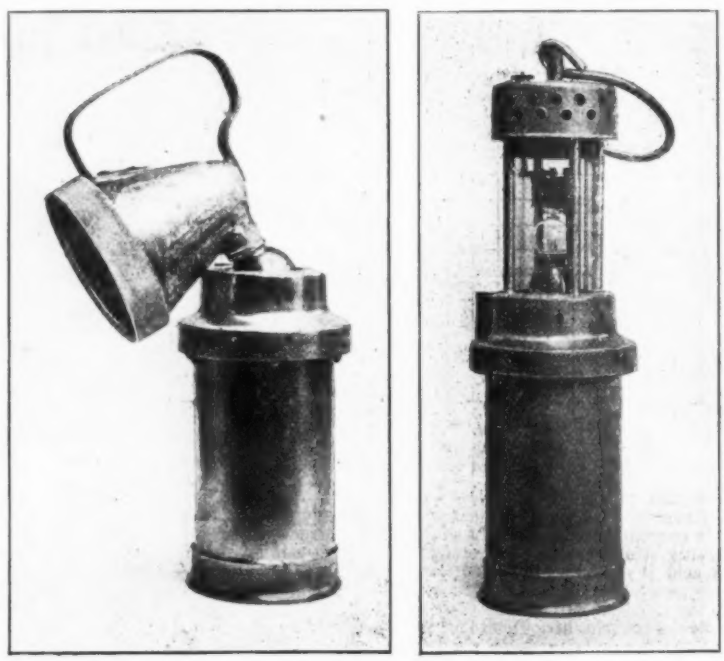
The electric lamp is inherently a safe lamp, but under certain conditions it is possible for the glowing filament of the bulb to ignite gas. To remove any possibility of damage the "Ceag" lamp is fitted with a safety fuse: The bulb has a taper socket and a central contact, making connection with a spring inside the reflector. An opposing spring fits over the pip of the bulb so that the bulb is carried between two springs, which protect it from bumps and jolts. If the outer glass should be broken the bulb rises and with it the bottom spring, which makes contact with the reflector, short-circuiting the accumulator and causing a tiny fuse in the reflector to isolate all the exposed parts, so avoiding any danger from ignition.

Objection was at first taken to the "pillarless" lamp on the ground of the apparent unprotectedness of the wellglass, but in practice it has been proved that this is an asset, as the lamp receives more care for this reason, and breakages are not increased, in some cases they have even been reduced.

To meet the demand for more light, a 4-volt lamp was introduced by the Ceag Co. Two of the ordinary circular accumulators are carried in an aluminium case and, by means of a simple arrangement in the lamp top, are automatically connected in series; it is made impossible to close the case if they are not placed in the correct way. The standard 2-volt fittings are used, including the safety fuse, and when used with the reflector down, a beam of 12 candle power is thrown forward, approximately four times the light given by the 2-volt lamp. Cap lamp reflection is much more effective than when the reflected light has to pass through thick wellglass, distortion due to refraction being considerable. If a white enamelled reflector, or one of frosted aluminium, is used, the distribution of the light is even and free from bright spots. In view of its many advantages it is surprising that its general use is confined to Scotland. Its restriction to this area is apparently due to prejudice.

To secure the increased efficiency of reflection given by the cap lamp, and be able to throw the beam in any desired direction—up or down and all round without any connecting wires—sounds like an ideal, but a lamp which fulfils these conditions has been designed. It has not yet made its appearance in public, and for the first time the details are now available: A head-piece, similar to that on the cap lamp, but larger, carries a lens and reflector. At the base of this is a ball joint which fits into a corresponding concave facing in the lamp top, fig. 3. This ball is split and the two parts are insulated, contact being made inside the lamp top. No live part is outside the lamp top, and as the spherical ball gives a universal movement, the light can be thrown in any direction; the collier can hang up his lamp and direct the beam on to his work. This is the nearest approach to the ideal in reflecting efficiency, and its tests underground will be watched with considerable interest. The design has been developed by the Ceag Co.

An electric lamp that will detect gas must be reliable, simple, and capable of being handled by the collier as easily as the lamp he is accustomed to use. A lamp, fig. 4, which approaches very closely to this ideal is now undergoing severe tests underground, and has so far justified the hopes of its sponsers. The principle on which it operates is simple: an ordinary electric safety lamp fitted with a special wellglass, carries above the bulb a small oil lamp; by the provision of double gauzes at the top and bottom the flame is made quite safe and the lamp is lit by a platinum filament. For general usage the ordinary electric bulb is used; when a test for gas is to be made, the light is switched off and, by rotating the lamp case, connection is made with an additional pair of contacts on the insulating plate. Current from the accumulator then flows up the supporting columns to the platinum filament, so igniting the wick of the small oil lamp. The current is then switched off, and the oil flame continues to burn, being regulated externally by a variable sleeve over the wick tube. The test for the presence of gas is carried out in exactly the same way as when using an ordinary oil lamp, and therefore requires no additional skill. Rigorous tests at collieries in different parts of the country will result in various minor modifications being shortly embodied. The manufacturers hope by this to go a long way towards solving a very old problem in a simple manner.



Figs. 3 and 4.—Experimental Swivelling (left) and Gas-detecting (right) Miners' Electric Lamps.

Reviews.

The Dynamo: Its Theory and Manufacture. Vol. III. Alternators. Sixth Edition. By C. C. HAWKINS, M.A.; M.I.E.E. Pp. xviii+572; figs. 710. London: Sir I. Pitman & Sons, Ltd. Price 30s. net.

The many earnest students of electrical machinery who have long awaited this—the concluding—volume of the latest edition of "The Dynamo," will not be disappointed, for the author is to be as heartily congratulated on this as on the earlier volumes. The new edition, however, has not been a matter of mere revision; in the present volume the subject of alternators has been treated in such a manner that we really have a new book before us. For example, the modern turbo-alternator, having reached the premier position among generators, is dealt with accordingly.

In the treatment of alternator armature windings, with which the book opens, no great degree of novelty is found or is to be expected. But when the e.m.f. induced in a loop on a toothed armature comes to be considered, an original method of explaining tooth ripples is introduced. For this purpose, a tooth cycle is divided into quarter stages, and the average e.m.f. induced per stage is deduced from the flux embraced by the loop in these positions. The results are interesting and it is to be hoped that designers will test this mode of attack by comparing curves thus predetermined with oscillograms.

A long chapter deals very fully with armature reaction in both salient-pole and non-salient pole alternators. The author is a firm believer in Blondel's two-reaction method of dealing with the effect of armature reaction in alternators for the purpose of design; he strongly maintains not only the accuracy of the method, but also its extreme simplicity. It is true that the formula for the direct (magnetising) armature ampere-turns is a little more difficult of establishment in the first instance, but this done it is only a question of inserting values. Starting on this basis, the writer has been at pains to calculate curves to be used for determining the regulation of alternators based upon the Blondel diagram instead of upon the simple triangle of magneto-motive forces. The latter method, so often used by others, including the reviewer, is strictly correct only for the ideal turbo rotor with uniformly slotted rotor and constant air-gap. As, however, modern practice has departed from the ideal by the adoption of non-slotted pole-centres, it will be seen that there is something to be said for the author's point of view.

The value that may be reached by the stator current on sudden short-circuit is discussed at some length, and in its pre-determination the author follows the simplified method in

which the resistances of the stator and rotor windings are neglected. The approximate result thus obtained is therefore a maximum which cannot be exceeded.

After further details of armature and magnet construction, the design of the salient-pole alternator and of the turbo-alternator are in turn considered. In the latter much space is devoted to a careful pre-determination of the full-load flux curve, the method employed being essentially the same as that set forth by the author in "Papers on the Design of Alternate-current Machinery," in conjunction with Mr. S. Neville, where it is used for the no-load condition. In the calculation, the fundamental of the flux curve is adopted as the origin of the specified e.m.f.—a process that will be found to make an appreciable difference in the actual maximum density.

An exhaustive study has been made to trace the air-flow in a turbo-alternator and to draw up a balance sheet of losses and rises of temperature

For the determination of the critical speed of the turbo-rotor, a new method of treatment is suggested. The author truly points out that when the rotor is still in the design stage nothing is known about the degree of mass eccentricity that may afterwards be found to exist in the finished rotor; consequently it is a waste of time to start from anything but a perfectly balanced shaft. For such an ideal shaft it is necessary to find some unique property, and it is argued that this may be found in a particular shape for the deflection curve, which the author determines by a process of trial and error.

The last chapter on the parallel working of alternators is a splendid example of the thoroughness of the author's work. Newer features in this connection are the treatment of two alternators when paralleled with unequal frequencies, and the action of damper windings in salient-pole machines in contradistinction to that in non-salient-pole machines.

Modern design is well illustrated with examples by such makers as the General Electric Co., Witton; Metropolitan-Vickers Electrical Co.; Société Alsacienne de Constructions Mecaniques; and the General Electric Co., of America.

Apart from the features to which special attention has been drawn above, the reader will find that the author has spared no pains in his endeavour to keep the book suitable for students and at the same time abreast of modern practice and theory. We know of no writer on electrical machinery whose work is more deserving of the title "classical" than the author of "The Dynamo."

Many of us pride ourselves on possessing the three volumes of Mr. Hawkins's work, but the permutations and combinations of the title on the cover backs do not appeal to an artistic taste. Though the publisher keeps the same position for his name, he does not use the same type.

Continuous Current Circuits and Machinery. By JOHN H. MORECROFT and FREDERICK W. HEHRE. Volume I. Pp. 467; figs. 377. London: Chapman & Hall, Ltd. Price 20s. net.

Professors Morecroft and Hehre, both of Columbia University, have collaborated to provide a volume on the direct-current side of electrical engineering that should prove of great value as a text-book in engineering classes. They very justly claim that the material here presented "seems to be about what the average engineering student wants whatever may be the branch of engineering in which he expects to specialise." It would also be an excellent book to put into the hands of any well-educated youth who is just starting upon an electrical apprenticeship, as it deals with the why and wherefore of the construction of electrical machines in an exceptionally clear and sensible manner.

In the early chapters dealing with electrostatics and simple current phenomena, the electron theory is used and the subject is viewed very largely from the electron standpoint. The chapters on electromagnetism, the electric circuit and self and mutual induction, also bear evidence of the hand of the experienced and painstaking teacher. The last-named section is especially well done, excellent use being made of oscillographic representations of inductive phenomena.

The treatment of practical subjects, such as meters and batteries, is equally happy and leaves little to be desired either in choice of subject matter or method of illustration. One curious little slip occurs in the description of the depolarisation of a battery: "this extra substance is generally an oxidising agent, to reduce (*sic*) the hydrogen set free at the positive pole of the battery: it is called a depolariser."

The best chapters in the book are those dealing with the dynamo electric machine. The first of these treats of the various parts, their functions, material and construction, and the reviewer has certainly never read a better account of the make-up of a dynamo. Not only are all the parts described and illustrated most carefully, but the general principles governing the design of electrical machines are explained by reference to actual calculations of their magnetic and electric circuits. The second chapter covers the subjects of commutation, field distortion, armature reaction, characteristic curves of shunt, series and compound-wound generators, and the pjarallel operation of generators. Then follows an equally comprehensive treatment of the direct-current motor and a chapter on efficiency, heating and rating—an excellent *vade-mecum* for the test-bed.

A chapter on Auxiliary Apparatus includes a general survey of switchgear, meters and regulators, and has also brief accounts of automobile starting and lighting equipment and electric welding—the latter appearing a little out of place in this particular chapter.

A very practical section on the location and cure of faults in electrical machinery completes the text book proper, and then follow a series of fourteen experiments in which the whole subject matter of the book would appear to be adequately reviewed by means of actual laboratory tests on generators, motors, meters, batteries and all the usual auxiliary apparatus found in a well-equipped electrical laboratory. The whole book has been thoroughly well done: it is in every respect a credit to its authors and is likely to find a wide field of usefulness on both sides of the Atlantic.

P. H. S. K.

Talks About Wireless. By Sir OLIVER LODGE. Pp. xiii+251. London: Cassell & Co., Ltd. Price 5s. net.

A new book by Sir Oliver Lodge is wont to receive a hearty welcome by a large circle of readers, and his "Talks about Wireless" will prove no exception. It is written for the people, simply, broadly, and large-heartedly. The Ether figures prominently, as one would expect, and Sir Oliver here clears away, once for all, the no-ether cobweb which has been spinning lately in the mind of the man in the street.

Part I, entitled "Radio in General," consists largely of a valuable, because authoritative, historical record of the early days of wireless. All non-essential details are omitted, the outstanding facts and the outstanding men alone are mentioned, and it is indeed pleasant to find full tribute paid to one great pioneer whose name is often omitted in this connection—Sir William Crookes. Sir Oliver's summary in a single paragraph on pages 46-47, in which are mentioned only three names, Maxwell, Hertz, and Marconi, might well be learnt by heart by all those who are accustomed to grapple with the distressing question: "Who Invented Wireless?"

Professor Elihu Thomson's claim that the Heaviside layer is unnecessary to explain transmission, is discussed generally, and though Sir Oliver says that he has "nothing dogmatic to say about it," it is clear that he certainly does not endorse that view.

Part II, entitled "Details that make for Efficiency," consists of an explanation of what should be done to minimise losses, and as an extreme case the author even visualises the possibility of immersing the receiving set in liquid hydrogen or helium, though, as he says, "such an arrangement could surely never be more than a curiosity." We notice that in considering the "Plain Aerial" from a theoretical point of view Sir Oliver concludes definitely that that system should be used for transmitting the S.O.S. signal, but in point of fact, as most of our readers are aware, it is not so used as practical considerations have been found to outweigh these theoretical advantages.

Part III, entitled "Calculations for Amateur Constructors," consists mainly of simple calculations of inductance and capacity, and is noteworthy for the fact that it is shown how simple these calculations become when the units of capacity and inductance are taken as lengths. For instance, what could be simpler than $L = 3\,n\,l$, the expression given for the inductance of a coil wound so as to give to that inductance a maximum value for a given length of wire?

Sir Oliver sends out this book as "a message of greeting to the great army of wireless amateurs and experimenters," and he may rest assured that his greeting is valued and welcomed by us all.

Electrical Engineers' Data Books. Edited by E. B. WEDMORE, M.I.E.E., F.Inst.P. Vol. III. Radio Engineering. (With Special Sections on Telegraphy and Telephony.) By J. H. REYNER, A.C.G.I., B.Sc. (Hons.). Pp. xxii+412; 314 illustrations. London: Ernest Benn, Ltd., Radio Press, Limited. Price 15s. net.

This is the third volume of the series of data books planned and edited by Mr. Wedmore, director of the British Electrical and Allied Industries Research Association.

In books of this description, where the aim is to give useful up-to-date data in a form convenient for practical application, it is all to the good if the author himself has had a wide practical experience of the subject in addition to sound theoretical knowledge.

Mr. Reyner possesses both qualifications in a marked degree, as, after a distinguished University career, he was employed for several years as a wireless engineer in the Post Office, and has recently joined the editorial staff of the Radio Press. He has thus acquired by practical experience a knowledge of just the sort of data required by professional radio engineers and amateur experimenters, and has produced a book of reference which will be found of great value to both these classes of practical workers in radio-telegraphy and telephony.

In this country, line telegraphy and telephony are a government monopoly, so that the section dealing with these subjects is confined to only 40 pages, and deals solely with matter which is of special interest to radio engineers, references being made to sources of more detailed information, should such be required.

The radio section proper, which takes up about half the book, is divided into sections, which deal, respectively, with calculations and measurements, tuning and radiation, thermionic valves, transmitters, receivers, masts and aerials, and miscellaneous data

The Appendices deal with mathematical, electrical, mechanical, and physical tables, electricity and magnetism, and wiring rules and regulations.

A certain amount of descriptive matter is included to make the data applicable to new developments, and frequent references are made to publications where fuller particulars can be obtained.

Wherever tested, the information given has been found accurate and up to date, except, indeed, that it has been noticed that no mention is made of the new method of applying inductive loading to submarine cables, an improvement which bids fair to change the whole scope of cable communication, and in the short-wave section, the statement that " perhaps the chief advantage of the system lies in the entire absence of any atmospheric disturbances on these wave-lengths " can hardly be justified by the results hitherto obtained.

There can be no doubt that Mr. Reyner has succeeded well in achieving what he says is the primary object of the book *viz.*, to be " a handy volume of reference which will be indispensable to everyone concerned with the technique of radio."

Electric Lighting and Power Distribution. By W. PERREN MAYCOCK. Ninth Edition, revised and enlarged by C. H. YEAMAN. Volume 2. Pp. 600; figs. 365. London: Sir Isaac Pitman & Sons, Ltd. Price 10s. 6d. net.

Few men have exerted so powerful an influence upon the methods of teaching electrical engineering as the late Mr. Perren Maycock. His books made an immediate appeal to the practical type of mind and provided a welcome alternative to the heavy, academic treatment of the subject so commonly found in the text books of twenty years ago. It would have been a pity indeed to allow so valuable a series of books as those which came from the pen of Maycock to fall into desuetude for lack of the constant revision and enlargement necessitated by the rapid growth of the subject, and the completion of this new edition of what was possibly his most important and valuable work is a matter upon which both publishers and revisers are to be congratulated.

Although the old sky-blue covers have given place to a more serviceable and pleasant green, Mr. Yeaman has well maintained the mode of presentation of the original author and has certainly brought the book thoroughly up-to-date. This volume contains eleven chapters, of which the first two deal with direct-current dynamos and motors and appear to be something in the nature of an overflow from Volume I. The six main chapters, however, are concerned with alternating currents and constitute a very well-balanced account of the subject. A.c. principles, a.c. circuits, alternators, transformers, a.c. motors, and a.c. distribution, are dealt with in turn, and each section is well illustrated by many worked examples and clear line diagrams.

In addition, there are chapters on batteries, meters and systems of distribution of direct current. The book is rounded off by the inclusion of a list of a hundred books for further study and a remarkably complete index both to the letterpress and the illustrations.

P. H. S. K.

Correspondence.

***Correspondents should forward their communications* at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

Rural Electricity Supply.

I was very much interested in Mr. W. W. Clarke's letter of the 8th inst., on the subject of wayleaves, and perhaps the following notes on my own experience may prove of interest.

Owing to the fact that many of the large estates are split up into small holdings, even a short line usually means a dozen or more landowners. When the line runs into miles, the work of getting wayleaves becomes, as Mr. Clarke says, of great importance. That this is a difficult job cannot be gainsaid, for if the line is to be erected at a reasonable figure for wayleaves, the hapless individual whose work it is to get them signed is in the unhappy position of a person asking favours with nothing to offer in return.

I agree with Mr. Clarke's suggestion that the standardising of pole rentals would simplify matters somewhat, but even this would not eliminate the annoying delays and expense of inquiries. I would further suggest that a committee be formed to inquire into what is a reasonable figure per pole, which could be applied generally, and then that compulsory powers be vested with the supply authorities for all cases where a line is to be erected for the public benefit. Probably there are numerous ancient statutes which have prevented this course being taken already.

In the actual work of obtaining signatures to the wayleave agreement, many lines of argument occur to one, but it can be safely said that there is no certain way to success. After a first interview the line to be followed will vary according to the temperament of the person dealt with.

Personal experience has convinced me that nothing is to be gained by trying to persuade a farmer that you are doing him a good turn by sowing his land with poles, even if the annual crop is unaffected by adverse seasons. Another method I found of little use is to try to point out that the rental paid for so many square yards occupied by the poles is far greater than that which would be paid for an equivalent area leased to a tenant. Poles other than those in hedges are in the farmer's way, and a knowledge of the cost of farming operations is desirable in such cases.

In tackling a new line every effort should be made to create a good feeling between the authority and the landowner, avoiding if possible all hints of what will happen should the landowner refuse to sign. The difficulties of any other route but the one decided on should be quietly emphasised, and a little sympathy with the landowner and his unfortunate position in the line of route is not wasted. A few general remarks as to the benefit gained from a supply of electricity to the countryside, and tactful illusions to the fact that the landowner in allowing the line to go over his property is a benefactor to mankind, sometimes work wonders. The above generally constitute the method adopted in successfully negotiating the wayleaves for a number of lines with rentals as low as 1s. per pole.

At the best, however, the work takes a long time, with numerous interviews and the use of unlimited patience and tact and with very little thanks from the powers that be. It can only be relieved by further powers being given to the supply authorities.

Harry G. Steel, A.M.I.E.E.

Tynemouth, *December 20th*, 1925.

The scant reference which is made to " wayleaves " in both the technical and daily Press makes Mr. Clarke's letter in your issue of December 18th particularly interesting. Also his suggestion for a standard rental; but might I suggest that the proper term is " Standard " standard rental.

I agree with your contributor that there is a great temptation to which authorities sometimes succumb to increase the price in isolated areas where the landowner is more than usually hostile or when wayleaves are nearly completed. Often this increased price represents a large sum which is in the nature of a gratuity, but that is from thenceforward quoted as a standard by the potential granter of wayleaves, and in this way the average rental throughout the country is gradually forced higher. Morally, the practice of varying from the standard price is a sin against other authorities as well as against the guilty ones. Each authority has its own opinion as to the meaning of " standard."

Strictly speaking, I suggest that this national standard rental should be nil or that of a peppercorn given annually, and the only payments that can in any case be justifiable are those of compensation for the amount of land that goes out of cultivation due to the presence of the pole legs; an annual sum to cover the cost of hand labour on the diamond-shaped piece of land which machines must avoid; and a small sum to cover extra work to the farmer due to reinstatement after pole erection. I estimate these items to be respectively 3d. (assuming an area of .121 square yard with 10-in. diameter double poles and land worth 2s. 6d. per square yard); 9d. in the second case, and 3d. in the third case (assuming initial cost of 10s. spread over the life of the pole).

Therefore this electrically optimistic total is that of 1s. 3d. per double pole per annum for the worst position. Of course the farmer will say that he ought to be paid for the fact that he is more unfortunate than his neighbour, who has no poles inflicted upon him, and for the offence to his sense of beauty, but since fields are not particularly chosen and this sense of æsthetic beauty usually proves to have a value which can be numbered in shillings, I feel justified in saying that no payment should be permissible on sentimental grounds. Even power companies prey upon themselves in this matter. A case occurred some years ago in which an authority applied for wayleaves for sixteen poles—offering of course its standard price—to a landowner closely connected with another company. In reply an answer was received that " the wayleaves would be granted only at a price 25 per cent. in excess of the above, and provided the latter company's standard wayleave form—enclosed—was used." On this was a printed clause which stated that a sum of shillings *which was 50 per cent. of the standard price offered* was paid for all poles (A or H) with stays and wires attached!

It is the range in the scale on which wayleaves, in the various parts of the country, are paid which varies from 6d. to 15s. per double pole, that compels me to ask Mr. Clarke to define more fully the term " standard rental." Assuming that he is connected with a company whose lines are proving highly remunerative immediately, having a comparatively high load factor, and who pay a high rent per pole (my knowledge of wayleaves is that the higher the standard price paid the less easy it is to obtain wayleaves, since the principle of " biting the hand that feeds " applies here) he will have to take into account those authorities who, on rural work, for instance, pay a very much smaller figure, which is necessitated by the ratio between expenditure and pole rent, and income from the line. A country line in rural work is a far more speculative proposition than a line which is perhaps erected to give a bulk supply previously authorised by the Minister of Transport. Anything more than the fixing of the standard by Act of Parliament, such as the power to be given to authorities to force the poles at this standard price, is a serious and drastic step. But if this is not taken it will merely mean that one will be forced to negotiate wayleaves at a possibly lower price than one is authorised to give now, when the last state would be worse than the first. I agree that it would do away with that bugbear of precedents quoted, often invented, of the higher prices which so-and-so gave for their poles, and I would only make

the stipulation that once the standard is fixed it be a punishable offence for more to be offered in any circumstances.

Wayleaves and wayleave assistants are the "salt of the earth," and Mr. Clarke's plea for more publicity is both timely and necessary. After all, his sometime despondency and feeling of incompetence are things which I know his brother wayleave assistants share in common. Perhaps the Electricity Commissioners will again consider the matter for us. At a meeting in London last week the head of one of the largest supply authorities stated that "wayleave difficulties and stringent regulations had made them give up overhead work." Such a statement makes one think furiously as to methods which can be adopted to obviate these difficulties, and if the principle suggested by Mr. Clarke can be shorn of the many pitfalls that beset it I feel sure that he has done the electricity industry in general, and all of us, a good turn by inviting discussion on the matter.

J. A. Sumner.

Northwich, *December 21st*, 1925.

Honesty in Advertising.

It is the duty of every man or company with anything to sell to advertise it to the best possible advantage. But it is also their duty to be accurate and not emulate the methods of quack medicine proprietors.

One of your advertisers in this week's REVIEW claims to make one in four of the a.c. industrial motors sold in this country. With as much knowledge of the subject as they have I would guess that they don't make one in ten. It is a guess on both sides as there are no available statistics, but they could make a start by issuing a chartered accountant's certificate as to the number they make.

The same firm, however, in an earlier advertisement (September 18th, 1925) are on more certain ground, although not more inaccurate than the above. They state that motors not manufactured on their "thorough" system "may" take 15 per cent. more current, presumably for the same duty, and cite as an example a 100-h.p. motor. From a well-known firm's catalogue I find that a four-pole, 50-period motor of this capacity has an efficiency of 90.5 per cent. with a power factor of .92. For 100 h.p. this means an input of 89.5 kVA. or 103.5 amperes at 500 volts. As this motor is supposed to take 15 per cent. more current than the advertised motor, the current for the latter would be 90 amps., or 76.9 kVA. which gives an efficiency of 97 per cent. at unity power factor, or perhaps if the power factor is less than this the efficiency may be a "leading" one.

I hope other engineering concerns will not take this form of advertisement as an example to copy. Truth in advertising all the time!

Truth.

December 18th, 1925.

Choosing and Using an Electric Washing Machine.

I am stating the opinion of several of your readers when I express surprise that you have given up so much of your valuable space to boosting a gas-consuming apparatus because it happens to be compelled to use a tiny electric motor for the really *essential* part of its operation.

Will the next step be a description of gas cooking and heating installations because they have to use electric fans to take the fumes away? Perhaps the gas journals will reciprocate by giving laudatory notices of electric grills if the old fish-tail burner is left alongside.

We are getting rather an overdose of gas just now. We had more than a whiff at the B.E.A.M.A. dinner. The tap was turned on at the last Institution meeting, and now our very own ELECTRICAL REVIEW is making us swallow the beastly stuff.

To get back to our muttons—if washing machines should have heating arrangements attached to them (a point which seems to have escaped the 4,000,000 users referred to on page 967) why should not the heating medium be electricity? Some of us object to having a poisonous high-explosive in our houses.

E. E. Sharp.

London, *December 21st*, 1925.

[We refer to this matter in our leading columns to-day.—EDS. ELEC. REV.]

Super-Station Switchgear.

The article on this subject in the ELECTRICAL REVIEW of December 18th contains a number of very sweeping statements which, in the opinion of the writer, are not strictly correct, and for this reason should not go unchallenged.

A consideration of the oil circuit breakers built by the five main switchgear manufacturers in this country will show that the clearances in air, and oil, tank sizes, quantity and head of oil, rupturing speed, &c., are very similar for a given rating. The cubicles, trucks, and cellular structures manufactured by these concerns are so much alike in construction and arrangement of gear that it is difficult to tell one make from another without reference to the nameplate.

The actual lay-out of switchgear for large power stations in this country follows very stereotyped lines except in cases where it has to be arranged to fit into a certain space.

Under these circumstances it is difficult to condone the author's statement that there is no unanimity of opinion as to the design of oil circuit breakers, or the physical design and lay-out of switchgear, and it certainly does not support his suggestion that the design of switchgear is a matter of guesswork only.

The author states that the isolated-phase arrangement of switchgear is no more expensive than the usual cellular type from a space and building point of view, and suggests that a duplicate busbar, duplicate oil switch method of control, arranged on the isolated-phase system, is a panacea for all ills, remarking that no expense is too great to expend on control gear if continuity of supply can be assured.

It has been generally agreed that the isolated-phase arrangement of switchgear requires more space, and hence is more expensive, than the usual cellular type; more especially where duplicate circuit breakers are employed. This appears to be the reverse of the author's experience; however, he will agree that from a space and building point of view at any rate, there is nothing to approach the duplicate busbar, single or duplicate oil circuit breaker compound-filled units which can be obtained in this country, and which have made a very prominent position for themselves in power-station service.

G. L. E. Metz.

Birmingham, *December 20th*, 1925.

Assisted Wiring.

"Manufacturer's Salesman" is suffering from a complaint well known in the electrical industry. I call it "Grumblitis"; it is diagnosed by a general wail, and ignorance of the real facts of the situation, as well as a "Funk-Hole" *nom-de-plume*.

Mr. Tate, who speaks with a deep knowledge of the contracting side of the industry and with authority, has definitely stated that he is in agreement with the assisted-wiring scheme as adopted in South Shields. I know many contractors who are also in agreement with the scheme, and have heard only one speak against it, and he had a temporary "bee in his bonnet."

May I ask "Manufacturer's Salesman" to consider for one moment who has been chiefly responsible for developing the installation side of our industry for the last thirty years.

In the United States the most successful supply companies have, from experiment, found it better to use the contractor than to execute their own installation work.

Your correspondent mentions the absence of contractors in the gas industry. He is still blind to the fact that that is of tremendous advantage to the electrical industry. How many gas users visit gas showrooms, or even see them or anyone representing the gas industry? Have the gas monopolies many independent people outside themselves with a practical knowledge of gas to put in a good word for it?

The great British public has a profound dislike for a complete monopoly, as most thinking people already know.

It can be proved conclusively that immediate co-operation between all sections of our industry is the shortest cut to sound development and success.

Contractors as a body will co-operate to-day.

Will the others?

H. T. Young.

London, *December 19th*, 1925.

Replies to Correspondence.

May I ask employers who reply to advertisements in your "Situations Wanted" columns, asking for references, &c., to acknowledge receiving them and to state if there is a possibility of the applicant being suitable for the position they have to offer?

I have had two experiences lately in which this has not been done. In one case references, &c., were sent, and nothing further was heard. In the second instance, after an interview when apparently everything was satisfactory, I was told that a letter would follow in the course of a few posts. It, however, did not arrive, and a letter sent to them a fortnight after the interview, asking how the matter stood, was not even answered.

Only those people who are seeking a job know the anxiety of waiting for the postman and the disappointment when he passes the door.

Dri Cell.

December 14th, 1925.

Will "Combustion Engineer" kindly send us his name and address?—EDS. ELEC. REV.

Survey of the National Coal Resources.—An important part of the work on fuel research undertaken by the Department of Scientific and Industrial Research is a survey and classification of the coal seams in the various mining districts. Committees have for some time been actively at work in the Lancashire and Cheshire and in the South Yorkshire areas. The Department recently appointed a committee for work in the North Staffordshire area. A further committee has now been formed to deal with the survey of the coalfields of Scotland. The Coal Owners of Scotland and the Mining Institute of Scotland are co-operating in this work.

Business Notes.

Commercial and Industrial Developments, Business Changes, Trade Opportunities, New Publicity Literature, Liquidations and Failures.

The "Electrical Review" Index.—The Index for the last half-yearly volume of the ELECTRICAL REVIEW (July to December), will shortly be published. Copies will be forwarded post free to those requiring them for binding or for reference purposes, if they will make application to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C.

British Patents in 1925.—An estimate of the number of patent applications filed at the British Patent Office in 1925 brings the total up to about 35,000, of which about 12,250 relate to motor vehicles and internal-combustion engines. Messrs. Hughes & Young, patent agents, state that a noticeable feature of the inventions relating to motor vehicles is the large number of patent applications relating to devices for reducing the dazzle or glare of headlamps. In the latter part of the year a large number of patent applications were filed in connection with wireless apparatus. At least one-quarter of the applications filed last year came from the United States and Germany.

The Danish Electrical Market.—In a recent survey of the market for electrical appliances in Denmark, *Commerce Reports* states that the popularity of vacuum cleaners is growing, the market being dominated by Swedish, Danish and German makes. Irons are also used to a large extent, most of them being of home manufacture. Apart from these two items there are few applications of electricity which enjoy a wide use. Electrical household appliances are in most cases bought direct from the foreign manufacturer. The retailers buy from the importer, who is usually also the wholesaler, and generally situated in Copenhagen. Local firms, when undertaking the representation of foreign firms, usually require this to be exclusive to them for the whole of Scandinavia, but experience has proved that it is more satisfactory in most cases to grant a Copenhagen agent the exclusive right for Denmark only.

An E.D.A. Film Display.—The British Electrical Development Association organised a display of electrical films at Australia House recently. These depicted in a very interesting manner the production of electrical goods at the works of leading British manufacturers and also presented palatable propaganda for a number of applications of electricity. The works films included the Rugby works of the British Thomson-Houston Co., Ltd., and Messrs. Johnson & Phillips, Ltd. Two films taken under the auspices of the General Electric Co., Ltd., showing electricity at work in the home were also exhibited, while a Vickers film showed erection work in progress at the Fulham electricity works.

Strowger Automatic Telephone Manufacture.—During 1925 the following Strowger equipments were completely manufactured in Liverpool at the works of the Automatic Telephone Manufacturing Co., Ltd., and installed for the Post Office. The number of lines is given in parentheses:—York (1,700), Headingley, Leeds (1,300), Stanningley, Leeds (800), Roundhay, Leeds (900), Chapeltown, Leeds (1,300), Torquay (1,230), Paignton (630), Newport (extension) (600), Cwmbran (80), Risca (60), and Leeds, 10 trunk equipments. In addition, manual telephone switchboards and equipment have been manufactured in Liverpool and installed at:—Weston-super-Mare (880), Accrington (extension) (500), Cardiff (1,500), Maidenhead (1,120), Worthing (540), and Blackburn (extension) 2 multiple sections. A number of important Colonial and foreign orders have also been executed, including Strowger apparatus consisting of 26,900 lines and trunking equipment for Tokio.

Electric Ovens for Battleships. — The Metropolitan-Vickers Electrical Co., Ltd., informs us that four of its ovens have just been ordered for the two new battleships *Rodney* and *Nelson*, at present being built in the yards of Messrs. Cammell Laird and Armstrong-Whitworth respectively. These ovens, while similar in general construction to the standard "Metrovick" oven supplied to bakers and confectioners, embody a number of important modifications designed to meet the special conditions obtaining on board ship. This is the second order which the company has received from the Admiralty for large electric baking ovens, a somewhat smaller but similar oven having been installed on H.M.S. *Tiger* about a year ago. The electric water heating equipment for the bakeries on board the *Rodney* and *Nelson* is also being supplied by the company. Other recent installations include large ovens for Messrs. Duncan & Foster, Manchester, Messrs. W. & R. Jacob, Dublin, Messrs. E. Cookson & Sons, Ltd., Preston, and Messrs. A. D. Wimbush & Sons, Ltd., of Birmingham.

Employment During November.—The December *Ministry of Labour Gazette* says that employment in the engineering industries generally remained bad, showing very little variation from the previous month's position, although it was fairly good in the electrical branch. The overall percentage of unemployed in the industry was 11.3, whereas in the electrical section it was only 5.6, although this was an increase of 0.1 per cent. during the month. In the electrical wiring and contracting industry the proportion of unemployed persons was 9.7 per cent., a decrease of 0.5 per cent., but unemployment in the electrical cable, wire and lamp manufacturing group rose by 0.5 per cent. to 6.5 per cent.

Industrial Lancashire.—A diagram prepared by Mr. A. H. Banks, employers' secretary of the North-Western District Council for the Electricity Supply Industry, and published recently by the *Manchester Guardian*, analyses the occupations of 1,689,056 persons employed in Lancashire, according to the 1921 census. This shows that, apart from the non-industrial group, the largest number of workpeople are employed in the engineering, shipbuilding and allied trades, cotton, mining, building, &c., and railway transport following in the order named so far as classified industries are concerned.

The International Forty-eight Hour Week.—Last week a joint deputation of employers and workers in the engineering industry interviewed the Minister of Labour upon the subject of the application of the principle of the 48-hour week internationally. It had previously been maintained by the interests represented by the deputation that it was a declared obligation of the parties to the Versailles Treaty that some sort of uniformity should be arrived at. It was said that while the hours worked per week in this country were 47, in France, Germany, Belgium and Italy they were supposed to be 48, although in practice they often extended to between 50 and 60. At the prior interview the Minister asked for an adjournment to enable him to communicate with the Governments of the countries specifically mentioned, and last week he said that replies had been received from the Belgian and German Governments expressing their willingness to take part in a conference on the matter; no definite replies had been received from France and Italy, but further steps were being taken.

Tramway Employés' Strike at Burnley.—About 50 men in the Burnley municipal tramway and other undertakings ceased work last week, the Corporation having declined to grant an increase of 10s. per week in the existing wages of £3 1s. 6d., arguing that the undertaking was to grant this advance on the basic wage of £2 16s. The men contend that other municipalities of smaller size have already done what Burnley refuses to do.

Telephone Development.—The Telephone Development Association has issued a booklet setting forth the advantages of being "on the 'phone" and explaining how to obtain them. It is well and humorously illustrated.

Copper, Lead and Rubber Prices.—Messrs. F. Smith and Co. report, December 29th: Copper (electrolytic) bars, £66, 5s. dec.; ditto, ditto sheets, no change; ditto, ditto wire rods, £76, 5s. dec.; ditto, ditto h.c. wire, no change.

Messrs. James & Shakespeare report, December 29th: No change in the prices of copper bars (best selected), sheet and rod; English pig lead, £36 10s., 10s. inc.

Messrs. Edward Till & Co. report, December 29th: India-rubber, Para fine, 4s. 1d., 1d. inc.

A Japanese in America.—Doctor Keiji Ito, consulting engineer to the Toho Electric Power Company and Professor at the Tokio Institute of Technology, spent a few days recently at the East Pittsburgh plant of the Westinghouse Electric and Manufacturing Company. Dr. Ito's chief reason for visiting the United States was for the purpose of making a study of the application of motors to industrial equipment and household appliances, including heating and lighting the home, and also the study of industrial heating. When approached on the question of the use of electrical appliances in Japan, Dr. Ito stated that the Japanese were not backward in taking to electrical home appliances, and that those who could financially do so had also installed electric heating appliances in their homes. He further stated that the use of gas had been practically eliminated by electricity.

Philips' Glow Lamp Works Extensions.—In connection with the new issue of capital by the Philips' Gloeilampenfabrieken of Eindhoven, to which reference was recently made, it is stated that the proceeds of the new issue are intended for the financing of extensions at Eindhoven, as well as abroad. Among others, the company is interested in the International General Electric Company by means of an interchange of shares, while Philips Lamps, Ltd., has been formed for sales in England.

A Valve Display.—An entire window on the Oxford Street frontage of Messrs. Selfridge's premises was given over last month to the display of "Osram" valves. Twelve circular openings were cut into a proscenium, and in each of the openings a valve of nickel-plated seating was fitted. These valves lighted up in pairs. Commencing from the bottom, the first two would light up, and when these went out the next two lighted, and so on, until the two in the centre of the top cross bar followed suit, to complete the entire set of twelve. When these were extinguished the process started again. The window furniture of gold stools and a table and blue curtain hangings were arranged to emphasise the colour scheme of the blue and gold carton of the "Osram" valve.

A Battery Locomotive Order.—For the constructional work of the Ben Nevis tunnel in connection with the new power station of the British Aluminium Co., Ltd., an order for 22 electric locomotives equipped with "Exide" batteries has been placed with Messrs. Joseph Booth & Bros., Ltd., Rodley, Leeds.

Unemployment.—During the week ended December 14th the number of unemployed persons registered at the exchanges fell by 33,750 to 1,127,500. Upon the equivalent date of 1924 the total was 1,158,475. The latest total includes 912,400 men, 26,800 boys, 164,700 women and 23,600 girls.

Social Events.—The annual dinner of the staff and employés of the Maidstone Corporation Electricity Department was held on December 19th. About 70 attended and the borough electrical engineer (Mr. E. E. Hoadley) presided. The chairman of the Electricity Committee (Councillor W. H. Martin, J.P.) was prevented by illness from attending, but the vice-chairman (Councillor S. P. Sanders) and the former chairman, Mr. J. H. French, were present.

At the annual social meeting of the staff of the Ayrshire Electricity Board, held at Kilmarnock recently, Mr. W. C. Bexon, chief engineer and general manager, who occupied the chair, was congratulated on the progress of the undertaking which now has a capital of about a million and a quarter. The adoption of electricity in coal-mining, it was predicted, would give a wide outlet for electricity in the future. The A.E.B. orchestra, trained by Mr. Upton, rendered selections during the evening.

The staff of the Electric Supply Corporation, Ltd., Dumbarton, and their friends, held a whist drive and fancy dress ball on December 16th. Mr. Dixon, the company's engineer for Scotland, thanked the staff for making the event a success. Mrs. Dixon presented the whist and fancy costume prizes. Mr. Gow-Russell, the resident engineer, and Mr. Clacher acted as M.C.'s.

Trade Announcements.—MR. F. H. SOWDEN, electrical and mechanical engineer, has removed to larger premises at Alpha Street, Dewsbury Road, Leeds.

The shareholders of HOLOPHANE, LTD., have accepted a favourable offer to purchase their American and Canadian rights. This will necessitate a reconstruction for the purpose of re-arranging the share capital, and to this end the company has just gone into voluntary liquidation. The position of the ordinary trade creditors will in no way be affected as they will be paid in full. A new company is being registered bearing the same name, but the business will continue as heretofore, with the same directorate and *personnel*.

THE RADIO EQUIPMENT CO. has opened demonstration and showrooms at Market Avenue, Huddersfield.

MESSRS. J. R. & A. H. BROOKING, who have purchased an electrical business at 44, High Street, Exeter, from the trustee under a deed of assignment from Messrs. Bird & Ewings, announce that that business will in future be known by the name of Brooking Bros. They wish to have a set of up-to-date electrical catalogues at the above address.

THE FOOLPRUFE ACCUMULATOR CO., LTD., Kettering Road, Market Harborough, desires to receive catalogues of electrical fittings and accessories.

MR. O. A. BROWN has opened an electrical and radio engineer's business at 78, West Princes Street, Helensburgh.

MR. J. A. BROOK has taken over new central premises at 24, John William Street, Huddersfield (Telephone No. 2929), to cope with increased business in electric lamp locks. He asks for copies of manufacturers' lists of electrical goods for his factoring business.

MR. ALEXANDER MILLER announces that he has given up business in Maidstone, and has purchased as a going concern the Central Garage (Newcastle-on-Tyne), Ltd., Carliol Square, Newcastle-on-Tyne. He was for five years chief draughtsman with Messrs. Mavor & Coulson, and was subsequently with various other well-known electrical manufacturing companies.

Some time ago (ELECTRICAL REVIEW, June 26th, 1925, p. 1015) we referred in some detail to the amalgamation of two of the oldest firms in the electrical fittings trade—Messrs. OSLERS (established in 1807) and MESSRS. FARADAYS (established in 1814). The developments that have taken place since the amalgamation include the opening of new branches at Glasgow, Manchester, Cardiff, and Belfast. The address of the company—Osler & Faraday, Ltd.—has now been changed to Lanthorne House, 89-91, Newman Street, Oxford Street, London, W.1.

Catalogues and Lists.—THE METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester.—Descriptive Leaflet No. 750/1-1, dealing with the Metropolitan-Vickers coal-cutter protection system. Fully illustrated.

THE MARCONIPHONE CO., LTD., 210-212, Tottenham Court Road, W.1.—A coloured poster advertising the company's two-valve receiver and the "Sterling Dinkie" loud speaker.

MESSRS. RICHSON & CO., LTD., 113, Oxford Street, W.1.—A well-illustrated catalogue (72 pp.) of artistic lighting fittings of all kinds—electroliers, bowls, shades, standards, brackets, statuettes, &c. Many of the illustrations are in colour.

THE LODGE FITTINGS CO., LTD., 57, Albert Road, Aston, Birmingham.—A price list of electric signs of various patterns.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, near Manchester.—The Christmas number of the "Chloride Chronicle," containing numerous notes and articles upon "Exide" batteries. The publication is profusely illustrated.

MESSRS. R. M. PAPELIAN, LTD., Wolseley House, Piccadilly, W.1.—An illustrated pamphlet dealing with the "Autopulse" fuel-supply system for i.c. engines which is based on a magnetic principle.

W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., Holborn Viaduct, E.C.1.—Catalogue W.I.5, containing illustrations and particulars of "Isco" cut-outs for house services, &c. Three ranges are dealt with, *viz.*, 15-30 A, 30-60 A, and 60-120 A.

MESSRS. HERBERT MORRIS, LTD., Loughborough.—Book 101, containing an illustrated description of the "Morris" electric runway.

THE HACKBRIDGE ELECTRIC CONSTRUCTION CO., LTD., Hersham, Walton-on-Thames.—A well-illustrated catalogue of the company's transformers.

BRITISH INSULATED CABLES, LTD., Prescot, Lancs.—List No. P.194, illustrating and describing "Prescot" a.c. prepayment meters.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—A mailing card bearing illustrations and prices of "Osram" valves.

THE SUN ELECTRICAL CO., LTD., 118-120, Charing Cross Road, W.C.2.—An illustrated list of display lighting equipment. It contains useful data on the subject of shop-window lighting, &c. Also a leaflet advertising "Bowyer-Lowe" radio products.

Calendars, Diaries, &c.—MESSRS. C. A. PARSONS & CO., LTD., Newcastle-upon-Tyne, have sent us a set of monthly date sheets for 1926, each of which bears an illustration of the company's turbines and other products.

THE LIVERPOOL ELECTRIC CABLE CO., LTD., of Linacre Lane, Bootle, Liverpool, has sent us one of its wall calendars with monthly slips and a sea view in colour.

MESSRS. AITON & CO., LTD., of Derby, have issued a large artistic wall calendar with monthly slips placed inconspicuously beneath a charming reproduction of "Marigold" from a pastel by I. M. Cohen.

A "memory jogger" has been sent us by the POWER MACHINERY TRADING CO., 17, Queen Victoria Street, E.C.4; this is a leatherette bound memoranda block.

A calendar received from the MARCONIPHONE CO., LTD., bears a portrait of Senatore G. Marconi, and monthly date slips.

A neat and human calendar has been received from MESSRS. FRANK V. COLLINS & CO., of 155, Kingston Road, Wimbledon, S.W.19.

A fine view in colour of "the longest electrical overhead span in the British Empire," very finely produced in the form of a wide wall calendar with the complete year in small monthly spaces beneath the picture, has been received from CALLENDER'S CABLE & CONSTRUCTION CO., LTD., of Hamilton House, E.C.4. The view shows a mile of route of overhead main at Blaengarw, South Wales, and includes four spans of 2,800, 325, 475 and 1,600 feet respectively.

Bankruptcy Proceedings—A. A. WATMOUGH, trading with another at 41, Town Street, Horsforth, near Leeds, and 1, Back James Street, Harrogate, electrical engineer.—The application for discharge of this debtor was heard on December 21st at the County Court House, Leeds; the proceedings took place in 1921. The Official Receiver supported the application, and the discharge was granted subject to debtor's consenting to judgment for £50.

H. L. WOOD, electrical engineer, 7, Taswell Street, Southsea, and late of Elm Grove, Southsea.—First meeting, January 8th, at the Official Receiver's offices, 87, High Street, Portsmouth. Public examination, February 1st, at the Court House, Portsmouth.

L. A. RADFORD, electrical engineer, 50, Welford Road, Leicester.—Trustee, Mr. E. Barlow, Official Receiver, 1, Berridge Street, Leicester, released December 14th.

W. K. M. WILSON, wireless apparatus dealer, 1, Mount St. Heanor, Derby.—First and final dividend of 3¼d. in the £, payable at the Official Receiver's offices, Nottingham, on January 4th.

J. E. ELLIOTT and J. M. ELLIOTT (J. E. Elliott & Co.), electrical engineers, 12, Broad Street, Oxford.—Trustee, Mr. W. J. H. Boyle, Senior Official Receiver, Carey Street, W.C., released December 18th.

J. F. GUEST (L. D. & J. Guest and Guest & Robinson), plumber, electrician, &c., 97, Great Horton Road, and Barkerend Road, Bradford.—Trustee, Mr. G. S. Smith, 17, Piccadilly, Bradford, released December 4th.

F. H. P. HOOLAHAN (Holloway Bros.), electrical engineer and instrument maker, The Hale, Highams Park, and 299, Holloway Road, N.—First and final dividend of 1s. 8d. in the £, payable at Carey Street, W.C.

Company Liquidations.—PARK ROYAL ENGINEERING WORKS, LTD.—The liquidator of the company, Mr. G. D. Pepys, Official Receiver, states that he is applying for his release; objections should be addressed to the Board of Trade within 21 days from December 19th. Mr. Pepys reports that the assets have been sold by the Receiver for the first debenture holders, who states that after the payment of the costs and the claims of the first debenture holders there will only be a small balance to be paid over to the second debenture holders. There will therefore be no funds available for distribution amongst either the unsecured creditors or shareholders.

WEST LANCASHIRE ELECTRICAL CO., LTD.—A meeting of members is called for January 30th at the offices of Messrs. Davies and Crane, Houghton Chambers, Southport, to hear an account of the winding up from the liquidators, Messrs. J. A. Bond and J. F. Warburton.

BELGRAVIA ELECTRICAL CO., LTD.—Winding up voluntarily. Liquidator, Mr. W. H. Lovatt, 21, Ironmonger Lane, E.C.

MARINE AND MECHANICAL ELECTRIC WELDING CO. (CARDIFF), LTD.—Winding up voluntarily. Liquidator, Mr. L. C. F. Robson, 146, Bishopsgate, E.C. Meeting of creditors January 11th, at the offices of the liquidator. Particulars of claims to be sent to the liquidator by February 8th.

For Sale.—Ipswich Board of Guardians invites offers for generating plant consisting of:—Two suction gas engines and producer plant, dynamos, motor booster, switchboards, &c., due to changing over to town supply. Messrs. S. D. Harrison and Sons have for disposal several steam generating sets, one Weir condenser, pumps, &c. The Liquidators of the British Empire Exhibition, Wembley, invite offers for surplus electrical equipment, consisting of motor generators, cables, meters, cut-outs, projectors, &c. Edinburgh Corporation Electricity Department has for disposal a quantity of scrap metal, &c., lying at the McDonald Road station. Mr. H. J. Shaw will sell by auction on January 7th, at 85, Newington Causeway, S.E., an electrical contractor's stock, and on January 20th, at 13, High Holborn, W.C., the stock of an electrical and wireless goods factor. (See our advertisement pages to-day.)

Book Notices.—We have received a copy of the "Interim Report on Artificial Light and X-Ray Therapy" (H.M. Stationery Office, price 1s.), issued by the Scottish Board of Health. Apart from dealing at length with questions relating to the application and administration of radiant energy for medical purposes, much useful information is contained on the theoretical considerations of the subject. The division of the spectrum shown diagrammatically adds to the interest of the publication. Ultra-violet radiation and treatment are dealt with extensively.

"Six-valve Supersonic Heterodyne Receiver." Pp. 21, with blue prints; illustrated. London: Igranic Electric Co., Ltd. Price 2s. 6d.—This is an instructional carton containing a fully-illustrated handbook, full-size lay-out drawings, wiring diagram, and drilling template for the construction of a six-valve receiver from the Igranic supersonic heterodyne outfit, which is a very attractive one. The set is very fully described in the illustrated handbook that is enclosed in the carton, and contains theoretical notes, a general description, and operating data. It is replete with diagrams and descriptive matter concerning the functions of a receiver built up under this system, and with interesting detail regarding the various methods of operating to the best advantage. A very valuable feature of the handbook consists of the constructional notes, which touch on the various operations of assembling and the ordered sequence of wiring, and the fitting up of the components. It will be found also that the series of questions and answers that apply to the many problems connected with the operating of a receiver on supersonic principles will prove most valuable to all who are interested in this phase of radio reception. The instructional carton is obtainable from all Igranic dealers.

"The Henley Telegraph." September-December, 1925. London: W. T. Henley's Telegraph Works Co., Ltd. Price 6d. net.—The excellent literary standard of this bright little journal is maintained in the current issue, which contains a number of interesting and amusing articles. We were particularly interested in a description of a golf match played in the vicinity of our offices—but we don't recollect it.

"Amplion Magazine." Pp. xvii+73. Vol. I, No. 3; illustrated. London: Alfred Graham & Co. Price 1s. net.—Besides the lighter fare, this, the first Christmas number of a well-printed and interesting house organ, contains several items of technical and practical value.

"Cosmos Radio Valves: A Talk to Valve Users." Pp. 20; 13 figs. Manchester: Metro-Vick Supplies, Ltd.—The somewhat bewildering array of thermionic valves now obtainable makes the provision of proper descriptive and explanatory literature to guide the purchaser in his choice of suitable types of valves to perform particular functions imperative. The object of writing the article which gives its title to this booklet was to explain, in language that can be understood by the non-technical reader, the meaning of the various technical terms and data generally set out in valve manufacturers' catalogues, and to show how the various constants can be calculated from the properties and performance of a valve, deduced from its published characteristic curves. So far as we are aware, nothing quite like this booklet has been attempted before; it should be of considerable interest to valve users, both amateur and experimental.

"*Journal* of the Institution of Production Engineers." Vol. V, No. 2, December, 1925. Price 1s.—In a short article on electrical gauging devices the principles of a few examples of electrical sizing indicators, employed during the processes of machining or grinding, and electrical gauging devices for testing finished components, are briefly described.

"The *Journal* of the South African Institution of Engineers." Vol. XXIV, No. 5, December, 1925. Price, 2s.

"Electrical Engineering for Mining Students," by G. M. Harvey. Pp. vii + 156; figs. 108. London: Sir Isaac Pitman and Sons. Price, 5s. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XLIV, No. 12, December, 1925. New York: The Institute. Price, $1.

A Swedish Re-organisation.—At an extraordinary meeting of the shareholders, held on December 19th, it was decided, says *Goteborgs Handels och Sjofartstidning*, to liquidate the Elektriske A.B. Chr. Bergh and Company. At the same time an agreement was entered into with a new company under the title of the Nye Elektriska Aktiebolag Chr. Bergh and Co., which has taken over the assets and liabilities and is continuing the business on the same lines.

Unemployment in Germany.—It is reported that on December 1st the number of unemployed persons in Germany was about 670,000, an increase of 200,000 in less than a month. Unemployment was most marked in the building trades.

French Electrical Experts in Madagascar.—At the request of the Governor of the island, a commission of French electrical experts, consisting of representatives of Schneider & Cie., La Compagnie Francaise d'Exploitation des Procédés Thomson-Houston, and the Compagnie Générale des Colonies is, it is reported, about to visit Madagascar with the object of studying the question of the electrification of the Tananarivo-Tamatave railway and also the Batsileo line. It is also proposed to supply the district traversed with electricity for lighting and power purposes.

Local Exhibition.—PREESALL.—The Urban Council Electricity Committee, in conjunction with the General Electric Co., Ltd., Manchester, held an electrical exhibition in the Parochial Rooms, Preesall, recently. The numerous domestic exhibits covered a wide field and each day a lady expert gave demonstrations in cooking and baking by electricity. The exhibition is said to have had a very beneficial effect in stimulating the sale and hire of electrical appliances in the district.

A Canadian Power Plant Contract.—Eight firms submitted bids for the new 5,000-h.p. turbines and generators required by the Winnipeg Hydro to complete the installation of equipment at the Point du Bois power plant. The Canadian Boving Company, Lindsay, Ont., submitted the low bid of $88,920 for the turbines. Other bidders were the John Inglis Company, of Toronto, the Canadian Allis-Chalmers Company, and the Canadian Vickers Company, Montreal. The Swedish General Electric Company, bidding through its Canadian office in Toronto, tendered the lowest bid for generators—$143,700. Other bidders for this equipment were the Canadian General Electric Company, C. A. Parsons & Co., Ltd., and the Canadian Westinghouse Company.—*Electrical News* (Toronto).

New Canadian Companies.—Affiliated Engineering Companies, Ltd., is the name of a concern recently registered in Toronto with a capital of $150,000 to carry on, *inter alia*, the business of electrical engineers and contractors.

Niagara Lamps, Ltd. (capital £40,000) has been formed in Hamilton, Ont., to carry on the manufacture of electric lamps, &c. Other companies recently constituted in Canada are the Skeely Electric Mfg. Co., Ltd. (Montreal), and Beeby Thermos Ranges, Ltd. (Montreal, capital $750,000), heating apparatus manufacturers.

German Tariff Reductions.—The *Board of Trade Journal* for December 24th published a list of articles, which, by the provisions of a commercial treaty between Germany and Italy, are to be subject to a lower rate of duty upon importation into either country. By virtue of the Anglo-German commercial treaty similar British goods entering Germany will enjoy the lower rates. The list includes "Dynamos (generators), except lighting and ignition dynamos for motor vehicles and except starters for combustion engines." The duty on articles under this head weighing 10 kg. or less is reduced from 80 to 40 Rm. per 100 kg.; on articles weighing more than 15 and up to 25 kg. the reduction is from 40 to 23 Rm. per 100 kg. Electrically-heated apparatus for making coffee is subject to the following duty reductions:—Weighing more than 3 kg. each, from 60 to 50 Rm. per 100 kg.; 3 kg. or less, from 75 to 70 Rm. per 100 kg.

Aluminium Production.—According to a tabular statement published in the Essen *Glueckauf*, the production of aluminium throughout the world amounted to 64,800 tons in 1913. Switzerland is credited with 12,000 tons of this total, France with 14,500 tons, Great Britain with 7,600 tons, Norway 1,500 tons, Italy 800 tons, the United States 22,500 tons, and Canada with 5,900 tons. The figures and countries of production for the past two years are given below:—

	1925. Tons.	1924. Tons.
Germany	15,900	18,700
Switzerland	15,000	20,000
German Austria	1,500	2,200
France	17,000	18,500
Great Britain	8,000	12,000
Norway	13,300	22,000
Italy	1,500	2,000
United States	85,000	85,000
Canada	10,000	8,000
Total	167,200	188,400

New Belgian Companies.—A new company has lately been formed in Brussels with a capital of 1,600,000 fr., and the title Société Belge des Accumulateurs Fulmen.

The S.A. Belge pour l'Equipement Electrique des Véhicules has been formed in Brussels with a capital of 250,000 fr., to manufacture and sell all kinds of electrical equipment for vehicles.

The Etablissements Paulet (S.E.P.) has been constituted in Brussels for the construction, equipment, and sale of electrical and mechanical systems, &c. (Capital, 250,000 fr.)

The S.A. Fluoris is another company recently formed at Brussels to undertake electric lighting by means of fluorescent tubes. (Capital, 200,000 fr.)

E.D.A. Activities.—The E.D.A. has produced a card relating to its advertisements which are to appear in the ELECTRICAL REVIEW and other electrical journals during this year. The card not only gives the dates, but also reproduces the distinctive border which is being employed for each advertisement.

New Italian Companies.—Among the new hydro-electric undertakings recently organised in Italy are the Società Idro-Elettrica del Sabato, Benevento, capital 162,000 lire; and La Società Idro-Elettrica del Tul, Travesio, capital 421,000 lire.

The Electrical Age.—The Sunlight League has issued No. 2 of *Sunlight*, "a journal of light and truth" (December, 1925). One of the articles is by Mr. D. N. Dunlop. It is entitled "Coal and Sunlight," and concludes by pointing to the necessity of avoiding raw coal combustion wherever possible, the substitution of smokeless fuels, and the introduction of a motive force into industry which will be clean, efficient, elastic and economic in operation. "Electricity," he says, "supplies this last and, from many points of view, the electrical age may be of greater value to the progress of humanity and of human existence, material, physical and even social, than any other age that has come and gone—bronze age, iron age, or steam age." Elsewhere in the journal is a reference to the first annual dinner of the Sunlight League held in May last, when the money to cover all expenses of the dinner was borne by "our very generous friends, the British Electrical and Allied Manufacturers' Association," Mr. D. N. Dunlop being "our host."

An Analysis of Unemployment.—In the *Ministry of Labour Gazette* for December the unemployment statistics from July, 1923, to October, 1925, are analysed according to groups and other circumstances; the result is illuminating in view of the fact that we are accustomed to look at the unemployment figures as a whole It is seen, for instance, that the coal mining industry, with its wide fluctuations, is the all-important factor of the situation. Indeed, during 1925 the curve of unemployment in the coal industry was reflected in a remarkable way in the general unemployment curve. Seasonal fluctuations are clearly illustrated, but it is observed that during 1925 the variations were far less violent than in the preceding year. A feature of the general curve is the remarkably low level reached in the second quarter of 1924, a position which has not been regained since. In June, 1924, the total of unemployed fell to 1,040,000; the lowest level reached in 1925 was just over 1,220,000 in April and May. The general and marine engineering curve is practically a gradually descending straight line, showing a very slow improvement.

Patent Application.—Application has been made for the restoration of patent No. 27,355 of 1913 granted to F. L. Hollister for improvements in or relating to magneto-electric machines.

Swedish Enterprise in Russia.—According to statements attributed to Mr. A. Linden, director of the Allmanna Svenska Elektriska A.B., a commencement of the supply of electricity from the Volkhoff hydro-electric works to Leningrad is expected to be made next May. The electrical equipment for this large station has been supplied by the Swedish company, while orders for electrical machinery and apparatus have also been received by the A.S.E.A. for other places in Russia. Mr. Linden stated that the company had initiated negotiations with the competent authorities with a view to securing a new concession for the workshops which the company carried on at Yaroslav before the revolution, the concession aiming not only at manufacturing, but also the right of free disposal of the manufactures. The idea was that the works in question, which in recent years had only been carried on by a Russian company on a small scale with the A.S.E.A. as an interested party, should be restored to the level of production which formerly prevailed, so that the number of persons employed would exceed 1,000. According to the concession proposal, the works would be under Swedish management and have an administration composed of certain percentages of Swedes and Russians and would be financed by the Swedish company. Confirmation of the scheme is also forthcoming from Russian sources, which announce the arrival in Leningrad of representatives of the Swedish company in the third week in December, together with Mr. Ericsson. In conversation with the representative of a Moscow newspaper, the chief representative of the Swedish company is reported to have stated that the construction of the Yaroslav works, which was in progress at the beginning of the revolution, was only stopped in November, 1917. This particular works was the only foreign undertaking in Russia which had not been subject to nationalisation, as the A.S.E.A. during recent years had executed orders for the Soviet Government. The completion of the works was to be commenced immediately on the grant of the concession from the General Concessions Commission, and some 1,500 workpeople would be employed on the production of generators, transformers, and other electrical equipment.

United States Electrical Exports.—In a recent issue of *Commerce Reports*, the exports of electrical goods from the United States during the first nine months of 1925 were reviewed. There was a slight decline in comparison with the previous corresponding period—from $63,281,553 to $63,031,943. There was a substantial decrease in transformer shipments which was not fully offset by rises in exports of a.c. generators and parts and steam turbine sets. Electric locomotives for mines and railways both showed declines; the former fell in value from $1,887,668 to $146,495. There were also small decreases in motor exports, while shipments of starting and controlling equipment for industrial motors fell in value by 50 per cent. On the other hand, there were important rises in the exports of radio equipment and associated lines, and domestic appliances. Lamps and lighting fittings, wiring materials, and insulated wires and cables, all showed substantial gains. The review proceeds to deal with the United States' customers and it is said that electrical exports to Europe show a satisfactory trend reflecting the improvement of economic conditions. Great Britain was again the leading European buyer, while Spain was second with 50 per cent. more than France, which occupied the third place. The strong position held by the United States in the South American markets was maintained, and it is stated that the influence of American-controlled public-utility developments in Panama and Guatemala is undoubtedly the reason for the growing importance of those markets as compared with others. In conclusion, our contemporary says:—"Considering the electrical export trade as a whole, the distribution throughout the world continues quite uniform, though its strength this year is to some extent maintained through the increased volume of radio exports."

United States Radio Exports.—The world-wide interest in radio is reflected in an increase of nearly 100 per cent. in the value of radio apparatus exported from the United States in October as compared with the same month of 1924. For October, 1925, Department of Commerce figures show the value of radio apparatus exported as $1,317,846; in October, 1924, the value of exports was $760,249. For the first ten months of 1925 radio exports were valued at $7,659,000.—*Reuter's Trade Service* (Washington).

A Striking Poster.—We reproduce below the wording of an attention-compelling poster which is being employed by the Torquay Corporation Electricity Department:—

DO
YOU
WANT
A BATH

JUST WHEN YOU FEEL LIKE IT WITHOUT HAVING TO WAIT FOR THE WATER TO GET

HOT ?

THEN HIRE
A BASTIAN ELECTRIC GEYSER
FROM
THE TORQUAY CORPORATION ELECTRICITY DEPT.
FROM 3/6 PER QUARTER.

A constant supply of Scalding Hot Water available day and night at an average cost of 3/- per week.

A Greenock Blotter.—The Greenock Corporation Electricity Department has issued an attractive blotter calling attention to the benefits of electricity. A coloured view of a fishing village appears on the card.

Lighting and Power Notes.

Ayrshire.—EXTENSION OF TIME.—The Ayrshire Electricity Board has intimated that it is to apply to Parliament to extend the time as now limited by the Ayr Burgh Electricity Act, 1922, for the compulsory purchase of land required for the purposes of the electricity undertaking authorised by that Act.

Barking Town.—EXTENSION OF SUPPLY.—The Electricity Committee has agreed to a scheme for the extension of electricity supply to the Eastbury area, at a cost of £22,100, and a loan of £4,600 is to be sought for the last portion of the scheme, which includes the erection of sub-stations in River Road. The Housing Committee has decided to wire 59 houses on the Eastbury estate for electricity.

LOANS SANCTIONED.—The Committee has obtained sanction to the borrowing of £5,500 for buildings and £10,000 for plant.

ELECTRICITY CHARGES.—The Electricity Committee has decided that, as and from the termination of the current quarter, the maximum demand charges for a.c. power supply shall be altered to:—35s. per kVA of the maximum demand per quarter, plus ½d. per kWh, subject to the standard discount, and that the treasurer and engineer shall report on the question of the revision of the charges for d.c. supply.

Bo'ness.—LOAN.—The Town Council is applying for sanction to a loan of £1,200 for cables and meters.

Canada.—ELECTRICAL DEVELOPMENT.—According to the *Electrical News*, the Manitoba Power Co. now requires the immediate installation of a new unit of 28,000 h.p., in addition to the 56,000 h.p. now in operation, as it has received a contract from the Spanish River Pulp and Paper Co. for the supply of approximately 30,000 h.p. for a new mill. It is also reported that the power company will proceed with the construction of a fourth unit of 28,000 h.p., thus bringing its total output up to 112,000 h.p.

Chelmsford.—ELECTRICITY SUPPLY.—At a recent meeting of the Town Council it was decided not to purchase the Electric Supply Corporation's undertaking at the estimated purchase price of £75,000. Efforts will be made to arrange for the company to continue to supply electricity under a scheme that would limit profits and enable the Corporation to acquire the undertaking at a future date upon reasonable terms.

Continental.—BELGIUM.—The Société Saboterie Mécanique, of Presgaux, Hainaut Province, in order to utilise the waste wood resulting from the manufacture of sabots, has decided to establish a power station consisting of three 250-h.p. gas engines and dynamos and one set of 120 h.p. The necessary gas for the engines will be furnished by gas producers in which the waste wood will be utilised. Negotiations are in progress for the supply of electricity from the station to 34 villages in the district.

Croydon.—LOANS.—The Electricity Committee has received sanction to the borrowing of £1,360 for feeders, and is applying for a further loan of £1,500 for domestic apparatus to be let out on hire.

STREET LIGHTING.—The Corporation has decided to convert 100 gas lamps to electricity at a cost of £1,411.

Faversham. — NEW ELECTRICITY CHARGES. — The Town Council has adopted the following new scale of charges for electricity for power:—First 12,500 kWh per quarter, 3d. per kWh; next 37,500 kWh, 2d.; beyond this amount, 1¼d. per kWh.

Glasgow.—PROGRESS DURING NOVEMBER.—The Glasgow Corporation electricity manager reports that 165 houses were wired in November, bringing the total to 1,606, and that the applications for the hire of appliances numbered 659, bringing the total to 9,074.

NEW SUB-STATION.—The Electricity Committee has recommended the purchase of land in Ibrox as a site for a static sub-station.

Grange-over-Sands.—ELECTRICITY SCHEME.—The Urban District Council has approved of an electric lighting scheme submitted by the consulting engineer, Mr. Burnett, and application is to be made for sanction to a loan of £8,200 to cover the cost. The mains and services of Messrs. Wilkinson are to be purchased for £2,000, and 40 street lamps are to be converted from gas to electricity.

Huddersfield.—ELECTRICITY CHARGES.—The Electricity Committee has received a deputation from the Huddersfield Chamber of Trade asking that the charges for electricity for the lighting and heating of shops should be reduced. The Committee has decided to consider the matter at a special meeting to be held at the end of the current financial year.

Irish Free State.—LUCAN.—The electricity supply for Lucan and surrounding districts, which was discontinued with the suspension of the Dublin-Lucan tramway service, was recently restored by arrangement with the Dublin United Tramway Co.

Keighley. — ELECTRICAL DEVELOPMENT.—The Corporation Electricity Committee has recommended that work be proceeded with at once upon the erection of a transmission line from Eastburn foundry and the laying of distribution mains for general supply in the township of Sutton. It is also recommended that an agreement be entered into between the Corporation and the Haworth Urban District Council for the supply of electricity to the Council. It is proposed that, where desired by the consumer, electricity shall be supplied by the Corporation to private houses only through pre-payment meters at 6d. per kWh with no meter rent.

London.—BATTERSEA.—The Electricity Committee is to proceed with the following works:—Services for electric lighting to 54 premises, £514; renewing the special mains to the Town Hall and Shakespeare Theatre in connection with the work of replacing the distributors on the north side of Lavender Hill, £521; replacement of old vulcanised bitumen distributors by three-core paper insulated and armoured cables—Park Road, Bridge Road, and Queen's Road—£2,448.

Mexborough.—LOAN.—The Urban District Council is applying for sanction to the borrowing of £20,000 for the extension of the plant at the generating station.

Millom.—APPLICATION FOR ORDER REJECTED.—The Urban District Council has been notified by the Electricity Commissioners that owing to the industrial position of Millom they cannot see their way at present to grant the Order for the electricity scheme, which it is estimated would cost from £10,000 to £12,000.

Nelson.—ELECTRICITY IN BULK.—The Electricity and Tramways Committee has received a communication from the Barnoldswick Urban District Council asking for terms for a bulk supply of electricity, and has recommended that a supply be given and that the Generating Station Sub-Committee consider the question of terms with power to act.

Peterborough.—LOAN.—The Corporation Electricity Committee is applying for sanction to a loan of £2,000 for the provision of meters.

Preesall. — INAUGURATION OF SUPPLY.—The electricity supply for the town was formally inaugurated on December 19th.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

WALTON AND WEYBRIDGE.—*Urban Electric Supply Co., Ltd.*—Lighting: From 11d. to 9d. per kWh.

FULHAM.—Lighting: From 4¼d. to 4¼d. per kWh. Power: From 1¼d. to 1¼d. per kWh.

DARLINGTON.—Lighting: All energy used during the lighter eight months, from 2d. to 1¼d. per kWh, and one kWh at 1¼d. (instead of 2d.) during the darker months for every two kWh consumed during the lighter months, and 3¼d. per kWh for all additional electricity consumed during the darker months. Power: First 3,000 kWh per quarter, 1d. per kWh, and ¾d. per kWh for energy in excess of this amount.

Plymouth.—NEW PLANT.—It was reported at a recent meeting of the Corporation Electricity Committee that the Electricity Commissioners had sanctioned the extension of the generating station at Prince Rock by the installation of a 6,000-kW turbo-alternator and the necessary auxiliary plant. Cable extensions were authorised by the Committee at an estimated cost of £1,397.

Rothbury.—ELECTRICITY SUPPLY.—The Rural District Council has agreed to support the application of the Newcastle-upon-Tyne Electric Supply Co., Ltd., to the Electricity Commissioners for sanction to distribute electricity within parts of the rural district.

Stoke.—ELECTRICITY SUPPLY.—The Town Council has under consideration a request from the Wolstanton Urban District Council for a supply of electricity at May Bank.

The Electricity Committee is to extend the mains in the Hanley area at a cost of £2,800, and in the Burslem area at an estimated cost of £4,000. A site has been obtained at Longton for the erection of a sub-station.

Stone.—SPECIAL ORDER.—The Urban District Council has passed a resolution authorising the Clerk to make application for the Special Order, for which the Council is applying, to be extended so as to include the parishes of Stone Rural, Darlaston, and Trentham. The Stone Rural District Council has decided to make no objection.

Walsall.—ELECTRICITY EXTENSIONS.—The Town Council has authorised the Electricity Committee to proceed with extensions of mains, and the installation of transformers, switchgear, &c., on consumers' premises at a total estimated cost of £1,750.

Willesden.—NEW PLANT.—The electrical engineer has reported that additional feeder cables are required in the Harlesden area, and estimates that the cost will be £4,000 for the extension of the sub-station and provision of a 1,500-kW rotary converter and necessary switchgear, and £4,152 for laying and jointing the feeder cables.

LOAN.—The Electricity Committee is applying for sanction to the borrowing of £25,000 for mains and services.

Wolverhampton.—TRANSFER OF UNDERTAKING.—The Town Council has agreed to transfer its generating station to the Joint Electricity Authority for the West Midlands, for which together with its portion of the main transmission line to Ocker Hill, the Council will receive £379,550.

Tramway and Railway Notes.

Cheadle and Gatley.—TRAMWAY LINKING-UP.—The Urban District Council has agreed to receive a deputation from Manchester Corporation to discuss the question of powers being obtained for joining up the city tramway system with the Council's existing routes.

Continental.—PORTUGAL.—It is announced that a Spanish syndicate has secured a concession for the construction of eight underground electric railways radiating from a central point in Lisbon. To supply the necessary power a hydro-electric station is to be established on the River Zezere at El Cabril, about 100 miles from the town. It is estimated that 20,700 h.p. is available.

Croydon.—NEW EQUIPMENT.—The Tramways Committee has recommended the purchase of tramway equipment at a cost of £7,600 in connection with the through-running arrangements with the London County Council.

Southern Railway Electrification.—The Southern Railway Company announces that the alterations to the track and stations, consequent on the coming electrification of the suburban services to and from Cannon Street, will begin on different parts of that line on January 1st, and that it will be necessary to make certain alterations in the morning and evening trains. Embraced in the portion of the company's system affected by these alterations are the main line, *via* Chislehurst to Orpington; the line from St. John's, through Catford Bridge and New Beckenham, to Addiscombe; the Elmer's End to Hayes branch; and the Grove Park to Bromley North branch. It is hoped that these lines will be electrically operated by the end of February. The section from London Bridge to Charing Cross, *via* Waterloo, is ready for opening, and will be brought into use at the same time as the section from Cannon Street to London Bridge, about to be taken in hand. At Cannon Street the work involves the reconstruction of the track, considerable alterations to the junction outside the station, and the closing down of locomotive depôts, to make room for electric sub-stations.

Modern Lighting in Ancient Buildings.

The Recent Lighting by Electricity of two Notable Cathedrals.

PROBABLY if it were realised more fully that electric lighting could be introduced into some of our fine old buildings without in any way detracting from their appearance, and indeed, with the result of exhibiting to better advantage their architectural beauty,, more

Fig. 1.—Nave, Looking West, Canterbury.

churches, cathedrals, and such buildings in this country would now be illuminated by means of electricity. The problem is not only to provide sufficient light for the purposes for which they were built, but also to enable the beautiful craftsmanship usually found in places out of the range of ordinary lighting, to be seen from all positions.

Cathedral Lighting at Canterbury.

An admirable example of such an installation may be seen in the Cathedral at Canterbury, where the first section of a scheme for the revision of the artificial lighting has recently been finished. The portions of the building so dealt with are the nave and transepts, where the sources of lighting have been placed directly and centrally overhead. The interior roof construction of the nave provides Gothic arches terminating in centrally placed rosettes at the apex, at a height of some 80 ft. above the ground, and separated by intervals of about 20 ft. It is in the rosettes that the electric lighting fittings are nested. There are eleven of these in all; each consists of a small silvered-glass parabolic reflector, 10 in. in diameter, directing the upper hemispherical rays to the floor level, the lower rays being utilised to illuminate the adjacent ceiling arches and the upper parts of the supporting columns. The power of the rays directly below each source of light amounts to 10,000 c.p.; between that point and 10 degrees from the vertical it falls to 5,000 c.p., and then falls rapidly to the normal power of the lamp. Thus the high power rays can only fall on the eye when it is looking abnormally, directly upwards. The illumination to which the eyes of the general public are exposed, even when looking at the ceiling arches, is from 500 to 1,000 c.p., the visible area of each source being 25 sq. in.

The results are thus free from any disadvantages of glare, and the illumination is claimed to be wonderfully even, such shadows as are produced being sufficient to give a necessary relief to the architecture. Shadows at the floor level of the nave are noticeably absent, the illumination at all parts being ample for reading in comfort. The ceiling lighting of the aisles will eventually be supplemented by fittings similarly placed to those in the nave. All irregularities of illumination, such as striation, so often produced by highly-directive reflectors, are avoided, it is claimed, by the use of "Multiplane" reflecting surfaces, an invention patented by Mr. Haydn T. Harrison, who has been responsible for the design of the installation. In the side transepts, where the area covered by a single fitting is greater, "Holophane" concentrating reflectors have been adopted. Each fitting is equipped with a 500-W gasfilled Osram lamp, with its lower part sprayed to prevent any possible direct view of the filament.

The fittings are of special design to conform with the construction of the roof. The only parts of each fitting showing are its reflector and the lower part of the lamp. The stonework of the arches is pierced at each point by a hole 5 in. in diameter, to a depth of from 18 to 24 in. The upper part of each fitting forms a copper chimney, passing through the hole, and thus allowing the heat from the lamp to escape into the roof. The main framework of the fitting is attached to the cylinder at its lower end, the upper end being provided with a shackle to which is attached a steel suspension rope which, in conjunction with a safety winch, is

Fig. 2.—Nave, Looking East, Canterbury.

used for lowering the fitting to near the floor level for the purposes of cleaning, effecting renewals, &c. Each fitting is provided with a two-pin plug socket placed with the winch in the roof; an extra safety clamp is also supplied. The wiring in the roof is run

in heavy-gauge screwed-steel conduit along the cross beams. Each fitting is controlled by a d.p. ironclad switch-fuse. The installation is arranged in three main circuits, which are controlled from the main switchboard in the crypt. A dimmer is installed to give the same even illumination at about one-third of the intensity at times when a subdued light is preferable. Probably the most interesting feature of the work is that on entering the nave normally, one does not notice that any artificial lighting apparatus exists. From the illustrations, figs. 1 and 2, it will be seen that the pointed Gothic arches of the roof are as well illuminated as the floor; the flutings of the wonderful perpendicular columns are all brought out in detail, and the tracery work of the great west window is accentuated; in fact, many lovers of architecture who have seen the window, state that fresh beauties have been disclosed, which were never visible in daylight. When the work is completed, the steps under "Bell Harry Tower" and the choir stalls will be lighted, making the vista to the east end complete.

The portions of the building so far dealt with have a floor area of 14,000 sq. ft., including the aisles which cover half this area. The floor of the nave is illuminated on an average to 2.5 foot-candles and the aisles to one foot-candle. With the ceiling and vertical walls, &c., the total area illuminated is about 50,000 sq. ft., with an average illumination of 1.5 foot-candles, equivalent to 75,000 lumens. This represents the utilisation of 85 per cent. of the luminous energy provided by the eleven lamps which, according to the B.E.S.A. specification, should produce 88,000 lumens. The wiring has been carried out by Messrs. H. M. Biggleston and Sons, of Canterbury, who also manufactured the special fittings. The photographs were taken by Messrs. B. & W. Fisk-Moore, also of Canterbury.

Fig. 3.—Nave and Chancel, Peterborough Cathedral.

Peterborough Cathedral Lighting.

The lighting of Peterborough Cathedral was recently converted from gas to electricity. The building is almost wholly Norman; the chancel, nave, and transepts are arranged in three stages, namely, the arcading, triforium, and clerestory. Most of the lighting is effected by means of fittings placed in the recesses on either side of the clerestory windows, so that the artificial light comes from practically the same direction as the daylight, and the fittings being beyond the normal angle of vision, are practically concealed from view up and down the length of the building. Each lighting unit consists of a specially-designed projector comprising three silvered-glass mirrors mounted in a suitable case, and is equipped with a 250-W projector-type "Mazda" gasfilled lamp. The lamp is supported in a porcelain holder suitably mounted to permit of its being correctly focused in relation to two of the mirrors, the third mirror being itself adjustable. The projector is mounted on an arm with a slide adjustment on a bracket attached to the wall of the building. The bracket is jointed, so that by releasing a screw the complete projector can be swung into a position where it can be easily reached for cleaning, &c., from the walk which runs round the clerestory. The beams from these projectors are trained diagonally downwards across the nave towards the bottom of the piers on the far side. A small lip at the bottom of the reflector deflects a portion of the beam upwards to that part of the walls above the fittings. This scheme was not possible beneath the central lantern tower, where eight special fittings are mounted nearly 100 ft. above the floor. Each of these is provided with a single silvered-glass reflector and a device to prevent any glare effect on the walls in the upper part of the tower. These fittings are supported on tubular arms, which are carried from a pivot attached to the wall of the building, and are provided with a counter-balance weight so that the units themselves, which project some considerable distance beyond the masonry, can not only be swung round to accessible positions for cleaning, but can also be adjusted in all directions from this position.

The lighting of such positions as the eastern end of the apse is effected by "Mirolux" trough reflectors placed in the triforium and the clerestory. The illumination throughout is particularly effective; fig. 3 shows the nave and chancel in the artificial light. An important feature of the installation is the absence of any fittings in the aisles, which depend for their illumination on light reflected from the nave. The result, shown in fig. 5, is a notably soft uniform illumination. Special wall lanterns in keeping with the surroundings are employed for the illumination of the vestries. The entrance in the west porch, fig. 4, is lighted by means of flood-light fittings inserted in the paving. The light from these units is thrown upwards on to the vaulting, whence it is diffused over the entrance way to the west doors. Strip spirals are placed vertically in front of the lamps to prevent them from being seen directly in passing from the porch to the cathedral, or *vice versa*.

The circuits are controlled by contactor switches, which are in turn under push-button control. Two contactor panels are situated on the triforium level, and the corresponding push-button panels are placed

at the back of the choir stalls on the south side. Multicore control cables, specially made by Messrs. Callender's Cable & Construction Co., Ltd., are run from the push-button boards through the crypt to the staircase at the south end of the south transept, up the staircase to the triforium, and to the contactor panels. Each of these cables is equipped with 37 numbered conductors; 16 pairs of push buttons are provided on each control

Fig. 4.—West Porch, Peterborough Cathedral.

panel. Each contactor panel is provided with 15 contactors, each furnished with a no-volt and an overload release. The panels are contained in well-ventilated sheet-steel cases mounted on concrete.

The building is wired throughout with the Henley wiring system; the lead-covered cables are placed out of sight of the congregation. Mr. H. A. Nevill, the city electrical engineer, acted as consultant for the work to

Fig. 5.—Lighting of the Aisles, Peterborough.

the Cathedral authorities. The design of the installation and the manufacture of the fittings were undertaken by the British Thomson-Houston Co., Ltd., and the wiring and erecting work by Messrs. Amies & Sons, contractors.

York Corporation's "One-Man" Tramcar.

A Real Effort to Reduce Operating Costs.

By J. A. BROMLEY, A.M.I.E.E., M.I.A.E., M.Inst.T.

GIVEN a route approximately three miles in length, with permanent way and overhead equipment almost new, an average income of 14.25d. per revenue mile run and little prospect of any immediate increase in revenue, with operating costs, interest, and sinking fund charges respectively 13.81d. and 3.00d. per mile—the problem to be solved is: how to reduce the deficit? The annual mileage on the route concerned is, with a maximum number of six cars, approximately 200,000 miles. If I could reduce the operating costs by an amount equal to half the platform labour costs (in my case it is 5.173d. per mile), an approximate net loss of £2,000 would be converted into a net profit of about £20 per annum. I decided, therefore, and my Corporation agreed, that under such circumstances the "one-man car" was the solution.

The use of the "one-man car" in this country has, so far, been very limited, and although many tramway managers and engineers have experimented with this type of car, it is only recently that an order has been placed in this country for a "one-man tramcar" as a complete vehicle. In designing the "one-man car," the principal factors which have been kept in mind have been: safety

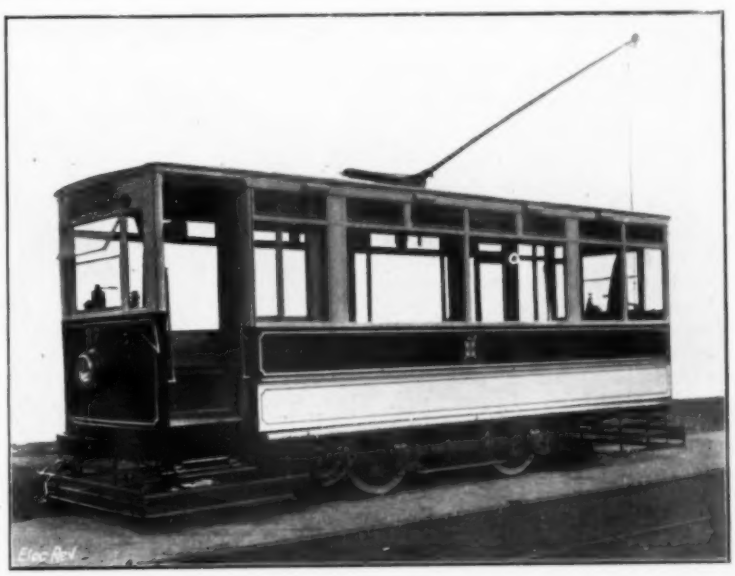


Fig. 1.—"One-man" Tramcar: York Corporation.

for the travelling public and simplicity in operation, as the driver, in collecting the fares and also in driving the car, must have as few complications as possible. It was decided, after consultation with the Ministry of Transport, that the maximum seating capacity for the first car should not exceed 24. From the experience gained by the operation of this car, I say without hesitation that this number can, with perfect safety, be increased to from 28 to 30. The accompanying illustrations show the car to be of the single-deck variety, mounted on a standard Preston 4-wheel truck having a wheel base of 6 ft., the overall length of the car being

Fig. 2.—Interior of Car, showing Driver's Platform.

23 ft. 6 in. The complete vehicle, when empty, weighs approximately 8 tons 7 cwt., the car body alone weighing about 3 tons 5 cwt. The very sound construction of the car is characteristic of the English Electric Co.'s practice.

A feature of the vehicle is the main and platform floors, which are run through at the same level and are made of $\frac{7}{8}$-in. tongued and grooved pine boards—a very good arrangement, as it avoids that step into the saloon which is so very objectionable. Platform vestibules are fitted at each end of the car, and the two doors are operated by levers from the platform; the doors work in conjunction with the folding steps, the door-operating lever on the platform being so arranged that when the door is open it is impossible for the driver to move the controller handle, thus preventing him from starting the car until the door is closed. The doors on both platforms are provided with a locking device consisting of a spring plunger in the floor and operated from the driving end by means of a "Bowden" wire, the control lever being within easy reach of the car controller, so that it is impossible for anyone to open the rear door unless a catch which is under the driver's supervision has been released. The lever operating the "Bowden" wire is fitted with a quadrant arrangement that fixes the lever in either the open or closed position, so that the driver, when moving from one end of the car to the other can unlatch the door at the driving end (which is under his personal control) while he is on the platform at that end. For an emergency exit when the quadrant lever is released at the driving end, the sliding doors are so balanced that the rear door can be opened by hand without difficulty. When the doors are open, a signal arm projects and indicates to oncoming traffic that passengers are about to alight from the front exit, the arm working in conjunction with the door and step. To avoid any risk of accidents at night time during loading and unloading, when the door opens an automatic switch operates a lamp above the door and throws a light on the step. In addition, an illuminated sign bearing the words "Danger, front exit car" is fitted on each dash. Depending on the way the car is travelling, the rear notice is illuminated, thus giving due warning to oncoming traffic.

With trolley reversers equipped throughout the system, the trolley will not require changing from the time the car leaves the depôt in the morning until it arrives back again at night.

Provision has been made for a smoking compartment at the opposite end to that from which the car is driven. The signal bells are of the "Numa" air-operated type with push buttons at convenient places. The driver is provided with a circular seat, and the lifeguards, of the Hudson and Bowring type, work in conjunction with the side-guards on each side of the platform. A Westinghouse straight air brake is arranged to work in conjunction with the "dead man's" controller, which has a "run-back" preventer and other features, as shown in fig. 3, but its operation is similar to that of the standard drum controller, the only difference being that the power-handle "dead-man's" device automatically operates the air brake and mechanically trips the circuit breaker. To restart the car it is only necessary to bring the controller to the "off" position and reset the circuit breaker, which is within easy reach of the driver. With the controller handle on the rheostatic brake notches, if the "dead-man's" lever is released, the emergency air valve will apply the air brakes, but the circuit breaker will not be tripped. Likewise, with the controller handle in the "off" position and the reverse lever in the "on" position, on releasing the "dead-man's" lever, the emergency air valve

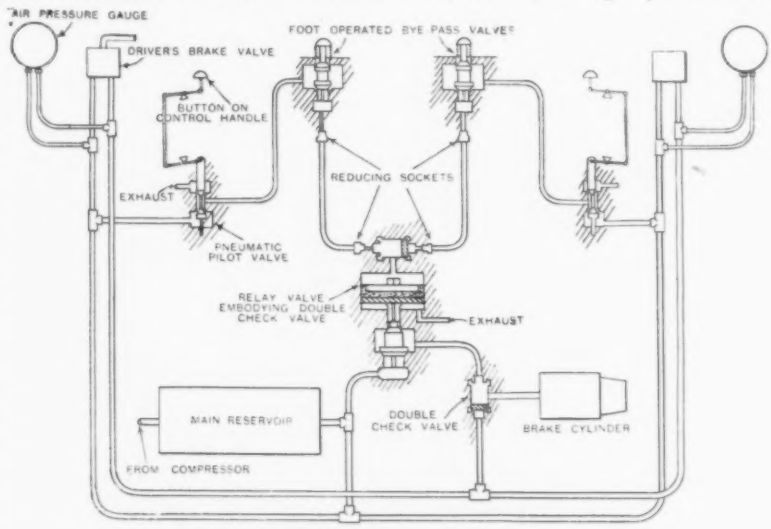


Fig. 3.—"Dead Man's" Pneumatic Control System.

applies the brakes, but the circuit breaker is not tripped.

A novel feature of this system is the use of a foot-operated pedal which, when depressed, renders the emergency air brake inoperative. This is used by the driver only when he releases the "dead-man's" handle for the purpose of taking fares, the object being to preserve the air pressure in the reservoirs.

The trucks are fitted with wheels 32 in. in dia-

meter, and two "English Electric" D.K. 29A motors of 30 h.p. at 500 volts on the one-hour rating, and the drive is through single-reduction spur gearing. The motors are self-ventilating, and are easily accommodated on the 3 ft. 6 in. gauge which is standard in York.

The air brake equipment, supplied by the Westinghouse Brake & Saxby Signal Co., Ltd., consists of one 6 cu. ft. air compressor coupled direct to a Metropolitan-Vickers 1¼-b.h.p. protected motor, two reservoirs, and a governor, which can easily be set to operate at any predetermined pressure; from experience I have found maximum and minimum pressures of 65 and 45 lb., respectively, to be the most serviceable.

The Minister of Transport, on whose behalf the car was inspected and tested by Lieut.-Colonel Mount, states that the details of the car have been well thought out, and has requested to be furnished with a report upon its operation under traffic conditions in six months' time.

Telegraph and Telephone Notes.

Australia.—NEW RADIO TELEGRAPH STATION.—The new Commonwealth Government wireless telegraph station at Camooweal, Queensland, which was opened in November last, completes the chain of stations across Northern Australia—Wyndham (W.A.) to Wave Hill (Northern Territory) thence to Camooweal, and then on to Brisbane. As there is no telegraph office at Camooweal, the station will bring a large area into closer touch with civilisation, and if squatters and private persons desire to link up with any of these stations, by either ordinary or wireless telephony, the telegraph department will be prepared to handle their traffic for them.

Belgium.—NEW TELEGRAPH CABLES.—The Belgian Government some time ago decided to install a telegraph cable between La Panne and Herbesthal, and another between Lille and Rosendael, with the object of opening up direct communication between Germany and England, on the one hand, and France and Holland, on the other. *The Times* now reports that the Minister of Railways, Posts and Telegraphs has received tenders for the laying of these long-distance cables from various firms, and has decided to give three-quarters of the work to certain Charleroi concerns, the remaining quarter being assigned to a German firm. It is anticipated that the work, which will cost the State about 70,000,000 fr. (approximately £660,000), will be completed within two years. It is expected that an increased revenue of 10,000,000 fr. a year will accrue to the Belgian telephone and telegraph administration from the new cables, this sum representing the approximate value of the communications which the Belgian administration is at present compelled to refuse owing to the absence of direct cables.

China.—WIRELESS TELEPHONE SERVICE.—The Ministry of Communications is taking steps to install a wireless telephone service between Tientsin and Shanghai.—*Reuter's Trade Service* (Shanghai).

Holland.—POLICE RADIO SERVICE.—A Commission representative of the police force and radio authorities has reported that wireless is useful to the police as an efficient and speedy means of communication, and that its cost, in comparison with the service it could render, is very small.—*Daily Mail.*

Germany.—TELEPHONES ON TRAINS.—Travellers on express trains running between Hamburg and Berlin will, from January 4th onwards, be able to telephone by wireless from the railway trains, and the service will be extended to other trains as soon as possible.—*Reuter* (Berlin).

Madeira.—WIRELESS STATION.—Marconi's Wireless Telegraph Co., Ltd., has recently commenced work upon the erection of a wireless station under its Portuguese concession near Caniçal, Madeira, on a small table-land about 800 ft. above sea level. The building is to be constructed of ferro-concrete and cement blocks, all of which, together with the water, has to be transported up the mountain side, a new road having been made for this purpose. The work is being done by a British firm, the Madeira Supply Co., Ltd., engineers, of Funchal, of which Mr. J. H. Quicke is the chief engineer.

Telephones in the Far East.—THE POLYGLOT PROBLEM.—Automatic telephones, a proportion of which are of British manufacture, are finding favour in the Far East; they appear to be the only satisfactory method of dealing with the large number of different languages (some 26) commonly spoken in the large towns. China possesses the largest automatic exchange of the Far East in that of the Dairen telephone system, which was installed in 1922; it is operated by the South Manchurian Railway Co., and is equipped for 4,800 lines. The Automatic Telephone Manufacturing Co. has recently completed four municipal automatic exchanges in Shanghai, and there is also an automatic exchange at Harbin, which was installed a year before that at Dairen, and is equipped for 3,000 lines. It was the successful operation of this exchange that paved the way for the Dairen project. Work has begun on the installation of an automatic system to serve the Tientsin district. Japan is replacing the Tokio system, which was destroyed by the earthquake and fire, by an automatic system of English make and of the type approved by the British Post Office.

The Telephone Service.—PROGRESS IN MANCHESTER.—The annual report of the Manchester Telegraph and Telephone Advisory Committee, signed by Mr. W. J. Medlyn, superintending engineer, shows that considerable progress has been made in the preliminary work connected with the introduction of automatic telephones in the Manchester district. Subscribers who will be served from the new Ardwick exchange are now using the numbers which will be allotted to them in the automatic exchange; the main building will be in Chapel Street. Complete new exchange equipment has been provided at Didsbury, Higher Broughton, Leigh, Saddleworth, and Delph, and a substantial addition has been made to the equipment at Oldham. New exchanges or equipment are to be provided at Atherton, Bramhall, Knutsford, Openshaw, Stalybridge, and Whaley Bridge. A relief exchange at York Street will provide for development pending the introduction of automatic working, and the new subsidiary automatic exchanges at Ardwick, Moss Side, and Collyhurst will be commenced shortly.

During the last year 8,974 new telephones were fitted, a net increase of 5,677, which constitutes the highest record for 13 years. The number of telephones was 70,958 in September, 1925, a growth of 115 per cent. in 13 years. The number of outstanding applications which could not be accepted owing to shortage of underground cables had been reduced at the end of October to 15. It is now generally practicable to give service on new lines in about 65 per cent. of the cases within one week of the receipt of the order, and 85 per cent. within two weeks. During the past two years the increase in underground cable mileage has been 50.151 miles, or an average of nearly 500 miles of wire per week. In the past 13 years the total has risen from 75,476 to 246,126.

The repeater stations at Fenny Stratford and Derby, on the London-Manchester cable, have given excellent service: that at Manchester, which was originally equipped for 30 repeaters, has been enlarged to 50 and 42 of these have been brought into use. Fifteen additional repeaters are now being installed.

The number of effective trunk calls in the Manchester district during the past year was 5,339,487, an increase of more than three-quarters of a million over 1924. Telegrams received by telephone from the public numbered 403,321, an increase of 61,500, and the local effective calls during the year numbered 46,391,000, an increase of over six million calls. On an average the telephonist answers the calling subscriber in 5.7 seconds. Street kiosks number 119, and a new feature is being introduced in connection with the Stockport automatic exchange in the shape of multi-coin boxes at call offices which provide for trunk calls.

The apparatus at the head post office for handling telegrams by telephone is being replaced by equipment of the latest type, and auto-Baudot apparatus has recently been installed to provide eight channels between Manchester and London. The volume of traffic makes the London-Manchester group the heaviest telegraph channel between any two offices in the world.

United States.—TELEPHONE FACTS.—There are now 10,000 telephone companies in the United States, more than twice as many companies as there are exchanges in the United Kingdom. In addition, there are approximately 30,000 rural telephone lines, operated largely on a co-operative basis, which do not rank as companies.

Radio Notes.

Australia.—NEW STATION.—The new broadcasting station (2KY) is owned by the Labour Council and will apparently be used for Socialist propaganda. According to the *Sydney Morning Herald* the Government was represented by Mr. A. C. Willis, vice-president of the Legislative Council, who, in officially opening the station ("an Australian product, built by Australian engineers") said that the development of wireless in Australia had been hampered by a Nationalist Federal Government, acting in concert with big vested monopolies. The Government's plan for the establishment of a high-power central station, and the erection in provincial and country centres of a series of relay broadcasting stations was now in the final stages of completion.

Canada.—WAVE-LENGTH.—The Department of Marine has authorised a wave-length of 52.51 metres as the "Trans-Canada" wave-length exclusively for long-distance relay work. This is also the authorised wave-length for communication with other parts of the Empire.—*Reuter* (Ottawa).

Latvia.—LICENCES AND TAXES.—H.M. Consul at Riga (Mr. G. Shepherd) has forwarded to the Department of Overseas Trade extracts of the regulations governing the use of broadcast radio receivers. Permits are issued for the installation and use of sets on payment of the subscription for one quar-

ter, the holder being entitled to acquire sets and parts thereof either from the Post and Telegraph Main Administration or from private firms possessing the requisite manufacturing or trading permit of the Administration. Quarterly subscriptions range from three lats in the case of State and municipal institutions, hospitals, &c., and six lats in the case of the ordinary subscriber, up to 90 lats in the case of kinemas, hotels, &c. All articles must be stamped according to the regulations, which came into force in November, 1925, the sealing charges being as follows: Receivers and amplifiers, 10 lats per valve (max. 40 lats for one apparatus); separate tuning apparatus. 10 lats; crystal receiving sets, 2 lats; valves 2 lats each; earphones 1 lat (double 2 lats); and loud-speakers from 5 to 20 lats, according to size (price). The total sealing dues, charged yearly for small appurtenances sold by commercial undertakings, vary from 100 to 500 lats, according to the town or district in which the sale takes place. Wireless apparatus is not specifically mentioned in the Latvian customs tariff, but is probably included in telegraph and telephone apparatus, the rate for which is 0.50 gold franc per kilogm.

Simultaneous Transmission.—ALTERNATIVE PROGRAMME DIFFICULTY.—The B.B.C.'s proposal to provide London with an alternative programme by using the old aerial at Marconi House, Strand, in addition to the 2LO aerial in Oxford Street, has been turned down by the Government's Wireless Telegraphy Board. According to the *Daily Mail* the Postmaster-General had regarded the idea sympathetically, but the Board (a sub-committee of the Imperial Defence Committee) considered that the Air Ministry in Kingsway would be hampered in receiving official communications.

Ships' Radio Apparatus.—SPARK AND CRYSTAL SETS.—At the Liverpool Centre of the Institution of Electrical Engineers, Mr. E. H. Shaughnessy, of the wireless section of the Post Office, recently lectured on "Post Office Wireless Stations." He said that listeners would experience less interference if they used coupled circuits on their sets. One of the advantages of the spark system from the shipping point of view was its broad tuning, though that was a defect from the point of view of the broadcaster. Loose coupling made spark signalling less offensive to the listener, but it could not be carried too far as it reduced the range of the transmitter. There were still something like 3,000 ships fitted with crystal receiving sets, which had a limited range, and until they were replaced with more sensitive and longer-range valve sets the Post Office would be obliged to use spark transmission.

Not long ago Mr. H. Bishop estimated that spark stations represented a capital of £2,000,000.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the "Electrical Review" in which the "Official Notice" appeared in our advertisement pages.)

Open.

Australia.—MELBOURNE.—March 16th. Postmaster-General's Department. Battery-charging power board equipment.*

Beckenham. — January 14th. Electricity Department. Water-heating and softening plant. (December 18th.)

Belgium.—February 24th. Belgian Post and Telegraph authorities, La Salle Madeleine, Brussels. Supply and installation of telephone switchboard tables with c.b. and luminous signals, for the interurban and regional telephone exchange at Verviers. Particulars (Cahier des Charges Special, No. 3-160) for 8¼ fr.

March 1st. Compagnie Intercommunale des Eaux, Liége (20, Rue des Guillemins). Nine sets of electric motors and centrifugal pumps at three water-pumping stations.

Birmingham.—January 9th. Tramways Committee. 50 tramcar bodies. Forms of tender (£2) from Mr. A. Baker, general manager, Tramways Offices, Birmingham.

Blackpool.—January 23rd. Electricity Department. One 2,500-kVA phase and frequency changer. (See this issue.)

Bulgaria.—Tenders are being invited by the "Watscha" Wassersyndicat, of Kritschim (Plovdiv), for the equipment of a steam-operated central electric power station, consisting of two steam turbines and generators, a motor generator, main and auxiliary transformers, and a battery of accumulators.

Croydon.—January 11th. Tramways Department. 12 sets of electrical equipment for tramcars. (See this issue.)

Dundee.—January 14th. Electricity Department. Two electrically-driven centrifugal drainage pumps controlled by float gear. (December 18th.)

Town Council. Electric lighting installation at day nursery, North George Street. Particulars from Mr. G. Baxter, city engineer.

January 15th. Harbour Trust. Electric lighting installation at New Wharf. Schedules from Mr. J. Hannay Thomson, general manager and engineer.

Eastbourne.—January 9th. Electricity Department. 12 months' supply of h.p. and l.p. paper-insulated cable. (See this issue.)

January 25th. Electricity Department. One 2,500-kW turbo-alternator, with condensing plant and pipework, one water-tube boiler and economiser, feed heaters and piping, one water-cooling tower. (See this issue.)

Edinburgh.—January 4th. Electricity Supply Department. Two 1,200-b.h.p., 6,600-V, 3-ph. induction motors. (December 11th.)

Egypt.—CAIRO.—February 20th. Director-General, Mechanical Department, P.W.M. Power plant for Giza.*

January 20th. Local Commissions Section. Electric motor and accessories at Manfalout waterworks.*

Ilkley.—January 20th. Electricity Department. Feeder cables, distribution cables, feeder pillars, and network boxes. (See this issue.)

London.—CAMBERWELL.—January 11th. Borough Council. Stores, including electric lamps, for 12 months. Particulars from Borough Engineer, Town Hall, Camberwell.

LAMBETH.—January 5th. Board of Guardians. Twelve months' supply of incandescent electric lamps. (December 25th.)

SHOREDITCH.—January 27th. Electricity Department. One 50,000-lb. water-tube boiler, with economiser, forced and induced draught, &c.; one 10,000-kW turbo-alternator, with condenser, pumps, &c. (December 25th.)

BETHNAL GREEN.—January 19th. Board of Guardians. Three Lancashire boilers for the hospital, Cambridge Road. Specifications, &c., from Mr. C. F. Jones, clerk to the Guardians, Bishops Road, Bethnal Green, E.

METROPOLITAN ASYLUMS BOARD.—January 27th. Installation of electric lighting at the Darenth Colony, Dartford (approx. number of points 2,300). (See this issue.)

Manchester. — January 12th. Tramways Committee. Steel girder tramway rails. Mr. H. Mattinson, general manager and chief engineer, 55, Piccadilly, Manchester.

January 6th. Board of Guardians. Electric lighting installation at the pathological and dispensing block, Crumpsall Infirmary. Specifications from Mr. A. J. Murgatroyd, architect, 23, Strutt Street, Manchester.

New Zealand.—WELLINGTON.—March 2nd. Public Works Department. Synchronous condenser and transformers for the Arapuni electric power scheme.*

30,000-V switch and protective apparatus for Lake Coleridge electric power supply.*

DUNEDIN.—February 26th. Otago Harbour Board. Motors, control gear, and cable.*

Rumania. — January 26th. Municipal authorities of Temesvar. 14 transformers and a quantity of lead-covered cables for the central electric lighting station in that city.

South Africa.—JOHANNESBURG.—January 21st. Municipal Council. 106 current transformers.*

February 26th. Motor-driven air compressor, with electrical equipment.*

S.A. Railways and Harbours. February 25th. Electrically-operated hoists for raising, &c., heavy locomotives, electrically-driven geared winches, &c.*

CAPE TOWN.—January 27th. Electricity Department. Oil-cooled transformers.*

Sweden.—The Swedish Water Power Utilisation Department, Stockholm, has invited tenders for the supply and installation of a 12,500-kVA outdoor transformer plant, and an indoor plant of a capacity of 10,000 kVA for the Aelvkarleby and Norrviken hydro-electric stations.

Thurnscoe.—January 12th. West Riding Education Committee. Electric lighting installation at new school. Specifications from Education Department, County Hall, Wakefield.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Barking Town.—Electricity Committee. Accepted:—
2,000 yd. c.h.p. 3-core cable (£851).—Hackbridge Cable Co., Ltd.
Steelwork for transformer house in Axe Street (£932).—Sanders and Forster, Ltd.

Bradford.—Tramways Committee. Accepted:—
Railless trolley cars.—Associated Equipment Co. and R. Garrett and Sons.

Croydon.—Electricity Committee. Recommended:—
Boiler feed pump (£341).—Mather & Platt, Ltd.

Glasgow.—Corporation. Accepted:—
Electric hot plate, for the Greendyke Street Home (£82).—Carron Company.
Wiring and switchgear (£55).—Corporation Electricity Department.

Tramways Committee. Accepted:—
Forged mild steel axles.—Glasgow Railway Engineering Co., Ltd.
Armature and field coils.—P. R. Jackson & Co., Ltd.
Steel pinions.—British Hele-Shaw Patent Clutch Co., Ltd.; Cammell, Laird & Co., Ltd.; W. C. Yuille & Co., Ltd.

Government Contracts.—The following Government contracts were placed during November, 1925:—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.

Dry batteries.—Edison Swan Electric Co., Ltd.
Condensers.—W. H. Wilson.
Electric annealing furnace.—Electric Furnace Co.
Motor alternators.—Crompton & Co., Ltd.
Motor generators.—Small Electric Motors, Ltd.
Starters, &c.—Watford Electric Mfg. Co., Ltd.
Repair of starters.—Marconi Co., Ltd.
Switchboards.—Whipp & Bourne, Ltd.
Switches.—Hawkers, Ltd.; Player & Mitchell; W. McGeoch & Co., Ltd.; Gabriel & Co.; Park Royal Engineering Co., Ltd.
Change-over switches.—General Electric Co., Ltd.; Park Royal Engineering Co., Ltd.
Fuse release switches.—Whipp & Bourne, Ltd.; Bertram Thomas.
W/t. switches.—General Electric Co., Ltd.; Whipp & Bourne, Ltd.
Switchgear (branch breakers).—Whipp & Bourne, Ltd.
K's new patent forced feed-oil cans.—J. Kaye & Sons, Ltd.

WAR OFFICE.

Battery, &c.—Chloride Electrical Storage Co., Ltd.
Electric light fittings, &c.—General Electric Co., Ltd.

AIR MINISTRY.

Voltage control boxes.—Pyne Mfg. Co., Ltd.
Underground cables (Altrincham).—G. E. Taylor & Co.
Ignition accessories.—Robinhood Engineering Co., Ltd.
Repair of receivers.—Muirhead & Co.

POST OFFICE.

Telephone apparatus.—British L. M. Ericsson Mfg. Co., Ltd.; International Electric Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Phœnix Telephone & Electric Works, Ltd.; Standard Telephones and Cables, Ltd.; Sterling Telephone & Electric Co., Ltd.; Telephone Mfg. Co., Ltd.
Testing, measuring, and protective apparatus.—British Thomson-Houston Co., Ltd.; Chamberlain & Hookham, Ltd.; Edison Swan Electric Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.; Walters Electrical Mfg. Co., Ltd.
Wireless apparatus.—Telegraph Condenser Co., Ltd.; Zenith Mfg. Co.
Cables.—British Insulated & Helsby Cables, Ltd.; Connollys (Blackley), Ltd.; Enfield Cable Works, Ltd.; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Pirelli-General Cable Works, Ltd.; Receivers of H. W. Smith (1920), Ltd.; Standard Telephones & Cables, Ltd.; Union Cable Co., Ltd.
Conduit and fittings.—Eureka Conduit & Fittings Co.; Longmore Bros.
Telephone cords.—British Insulated & Helsby Cables, Ltd.; London Electric Wire Co. & Smiths, Ltd.; Phœnix Telephone & Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; Standard Telephones and Cables, Ltd.
Ducts.—H. R. Mansfield, Ltd.
Lamps.—Cable Accessories Co., Ltd.; A. C. Cossor, Ltd.; Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.
Battery plates.—Alton Battery Co., Ltd.
Cable distribution plugs.—Siemens Bros. & Co., Ltd.
Battery-charging sets.—Stuart Turner, Ltd.
Lead sleeves.—British Insulated & Helsby Cables, Ltd.
Electric trucks.—W. Goodyear & Sons.
Copper binding wire.—Enfield Cable Works, Ltd.; Pirelli-General Cable Works, Ltd.
H.d. copper wire.—Novill Druce & Co., Ltd.
Tinned copper wire.—Pirelli-General Cable Works, Ltd.
Manufacture, supply, drawing-in and jointing cable.—Swansea-Ammanford: W. T. Glover & Co., Ltd. Walsall-Lichfield: British Insulated and Helsby Cables, Ltd. Marks Tey-Ipswich: Johnson & Phillips, Ltd.
E.h.p. transformers (G.P.O. (South) sub-station).—Siemens Bros. & Co., Ltd.
E.h.p. and l.p. switchgear (G.P.O. (South) sub-station).—A. Reyrolle and Co., Ltd.
Electric lighting, Leicester Telephone Exchange.—T. H. Wathes & Co., Ltd.
Private branch exchange telephone equipment.—Carpet Trades, Ltd. (Kidderminster); Lancashire County Council offices (Preston); Watney, Combe & Reid, Ltd. (Mortlake, S.W.); the British Mannesmann Tube Co., Ltd. (Newport, Mon.); Relay Automatic Telephone Co., Ltd. Pearson, Dorman, Long & Co., Ltd. (Betteshanger Colliery, Kent); Standard Telephones & Cables, Ltd.
Telephone exchange equipment.—Sherwood (Nottingham), Arkwright Street (Nottingham): Automatic Telephone Mfg. Co., Ltd.; sub-contractors: Tudor Accumulator Co., Ltd., for batteries; Crompton and Co., Ltd., for charging machines. Basford (Nottingham): Automatic Telephone Mfg. Co., Ltd.; sub-contractors: Tudor Accumulator Co., Ltd., for batteries; Crompton & Co., for charging machines; Newton Bros. (Derby) for ringing machines. Buckhurst: Automatic Telephone Mfg. Co., Ltd. Seven Kings: Siemens Bros. and Co., Ltd.; sub-contractors: Chloride Electrical Storage Co., Ltd., for batteries; Crompton & Co. for ringing machines. Dumfries: Siemens Bros. & Co., Ltd.

H.M. OFFICE OF WORKS.

Wiring, &c. (Charity Commissioners' office, Ryder Street, W.).—Electrical Installations, Ltd.

CROWN AGENTS FOR THE COLONIES.

Battery material.—Siemens Bros. & Co., Ltd.
Copper cable.—T. Bolton & Sons, Ltd.
Ceiling fans.—General Electric Co., Ltd.
Electric headlights and spares.—C. Stewart & Co., Ltd.
Porcelain insulators.—Doulton & Co., Ltd.
Lightning arresters.—International General Electric Co., Ltd.
Transmission line material.—Callender's Cable & Construction Co., Ltd.
Telegraph poles.—Bullers, Ltd.
H.d. copper wire, &c.—F. Smith & Co.; Elliotts Metal Co., Ltd.
Wood separators.—Chloride Electrical Storage Co., Ltd.

Hornsey.—Electricity Committee.

Meters and time switches.—Chamberlain & Hookham, Ltd.; Ferranti, Ltd.; Reason Mfg. Co., Ltd.; and Venner Time Switches, Ltd. (Recommended.)
Disconnecting boxes (£23 per box).—Motor Gear & Engineering Co., Ltd. (Accepted.)

Hull.—Electricity Committee. Accepted:—

Cooling towers (£5,539).—Davenport Engineering Co., Ltd.

Kilmarnock.—

Electrical equipment of new premises, for D. Lander & Sons.—W. Dow and Sons, Ltd.

Lamp Contracts.—Siemens & English Electric Lamp Co., Ltd., has received contracts for 12 months' supplies of train-lighting lamps from the London & North-Eastern Railway Co.; for traction lamps from the Dublin United Tramways; and for vacuum gasfilled and carbon-filament lamps from Geo. Thompson & Co. (Aberdeen Line). The Great Western Railway Co. has placed a 12 months' contract for "Osram" gasfilled lamps with the General Electric Co., Ltd.

Lichfield.—Town Council. Accepted:—

Transformers and switchgear (£2,790).—Ferguson, Pailin, Ltd.
Cables and road work (£20,488); public lighting cables (£2,579); barracks line (£2,350).—W. T. Henley's Telegraph Works Co., Ltd.

Southampton.—Harbour Board.—In connection with the new sub-station to be erected on the Town Quay, 24 tenders were received for the electrical equipment, only one of which was for the complete specification. The following tenders were recommended for acceptance by the Works Committee:—

Carrick & Sons, Edinburgh, for sections 2, 3 and 4, subject to the fitting of controllers and panels made by Allen, West & Co., at a total cost of £8,050.
George Ellison, section 5, for £749.

The Board, which at the last meeting accepted a contract of £1,000 for the construction of the sub-station, adopted the report, and will take its supply of electricity from the Corporation Electricity Department.

South Africa.—CAPE TOWN.—Recommended:—

43 tons bare copper wire (£3,534).—Davis & Soper, Ltd.
40 tons ditto (£3,505).—Telegraph Mfg. Co., Ltd.

Tynemouth.—Electricity Committee. Accepted:—

Cable (£327).—Macintosh Cable Co., Ltd.

Wakefield.—Rural District Council. Accepted:—

Installation of pumps, electric motors, &c., in connection with drainage scheme of Shay Lane, Walton, near Wakefield.—Pulsometer Engineering Co.

Windsor.—Town Council. Accepted:—

Electric wiring at the Town Hall (£113).—Bridger & Son.

Yarmouth.—Electricity Committee. Accepted:—

Switchgear (£2,750).—English Electric Co., Ltd.
Two water-tube boilers (£25,570).—Babcock & Wilcox, Ltd.

Forthcoming Events.

Junior Institution of Engineers.—Friday, January 1st. At 39, Victoria Street, S.W. At 7.30 p.m. Kinematograph Lecture, "The Manufacture of Ordnance" and "The Rolling Mills and Crucible Melting Department at the River Don Works of Vickers, Ltd.
Friday January 8th. Paper on "Some Notes on Salesmanship," by Mr. A. J. Simpson.

Electrical Power Engineers' Association.—Friday, January 1st. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 7 p.m. Lecture on "Automatic Boiler Control," by Mr. H. W. Holland.

Nottingham Society of Engineers.—Monday, January 4th. At the Victoria Station Hotel. At 7.30 p.m. Lecture on "Patents for Inventions," by Mr. E. Potter.

Royal Institution of Great Britain.—January 5th, 7th, and 9th. At 21, Albemarle Street, W. At 3 p.m. Lectures on "Old Trades and New Knowledge," by Sir William Bragg

National Association of Supervising Electricians.—Tuesday, January 5th. At the Junior Institution of Engineers, 39, Victoria Street, S.W. At 7.15 p.m. Paper on "The Ultimate Position of the Single-phase Motor," by Mr. W. A. Benger.

Roentgen Society.—Tuesday, January 5th. At 32, Welbeck Street, W. At 8.15 p.m. Papers on "A Combined X-ray Tube and Vacuum Pump Unit" and "The Industrial Uses of X-rays—the Present Position," by Mr. G. W. C. Kaye; and on "The Measurement of Radium During Radio-active Growth," by Mr. A. F. Dutton.

Institution of Heating and Ventilating Engineers.—Wednesday, January 6th. At Caxton Hall, Westminster, S.W. At 7 p.m. Paper on "Pump Circulation," by Mr. J. R. Preston.

Electrical Society of Glasgow.—Wednesday, January 6th. Paper on "Wiring Rules and Defects," by Mr. H. M. Stronach.

Institution of Electrical Engineers.—Thursday, January 7th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "The Past, Present and Future Development of Wireless Telephony," by Capt. P. P. Eckersley.

(North-Western Centre).—Tuesday, January 5th. At the Engineers' Club, Manchester. At 7 p.m. Lecture on "Co-operative Business Building for the Electrical Industry," by Mr. J. W. Beauchamp.

(Wireless Section).—Wednesday, January 6th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Frequency Variations in Thermionic Generators," by Lt.-Col. K. E. Edgeworth.

Edinburgh Electrical Society.—Friday, January 8th. At the Royal Society of Art, 117, George Street. At 8 p.m. Social evening.

Society of Technical Engineers.—Friday, January 8th. At the Queen's Hotel, Birmingham. At 7.30 p.m. Paper on "The Research Factor in Cable Making," by Capt. P. Dunsheath.

Association of Mining Electrical Engineers (Western District Sub-Branch).—Saturday, January 9th. At 62, Wind Street, Swansea. Paper on "Electrical Costing Applied to Collieries," by Mr. C. E. Yates.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

Tinned paper suitable for the manufacture of condensers.
BELLTONE (for cleaning accumulator plates).

We also have an inquiry for the present address of Marsdens (Live Publicity), Ltd., late of Bolton, and manufacturers or proprietors of Humannekin Turntables.

Notes.

Big Radio Law Suit in the United States.—Under the title "Sixty-Million-Dollar Radio Suit Filed by Fessenden," the *Electrical World* of December 19th states:—"Suit declaring triple damages amounting to $60,000,000 was filed December 3rd in the United States District Court at Boston on behalf of Prof. Reginald A. Fessenden, of Chestnut Hill, Mass., against the General Electric Co., Radio Corporation of America, Westinghouse Electric & Manufacturing Co., Western Electric Co., Inc., United Fruit Co., Wireless Specialty Apparatus Co., and International Radio Telegraph Co., under the Sherman Act and Clayton anti-trust law. The defendants are charged with lessening and finally destroying competition, restraining commerce and injuring the plaintiff through combination and control of radio apparatus manufacture and use. A list of between two hundred and three hundred inventions, title to which, it is contended, resides in the plaintiff, is appended to the bill."

Swiss Railway Electrification.—The Federal Railways of Switzerland, we learn, have nearly completed the electrification of the section between Geneva and Lausanne. This section has offered no technical difficulties beyond the raising of a foot-bridge near Allaman station, but the electrification work has been difficult owing to the traffic beyond and between the two cities, especially at Geneva, and the running of special trains. It is much to the credit of the electrical engineers that they have finished their work two months in advance of the scheduled time. Trial trips are being run by means of a testing-carriage (wagon d'essai) for the contact points and an overhead trolley for the wires, both drawn by an ordinary steam engine. Cable boxes have been established a kilometre apart along the line, and telephones have simplified matters where there have been breakdowns and unexpected traffic to cope with. It is estimated that electric traction will supersede ordinary locomotion for all trains on the section after January 5th, 1926.

R.A.F. Wireless School.—The Electrical and Wireless School near Winchester at Flower Down has now sent three entries of apprentices to the Central Trade Testing Board, and in no case has a lad failed. This is a "record" held by no other R.A.F. training centre. Sir Philip Sassoon, Under-Secretary of State for Air, recently inspected the school, some 1,100 strong, and the workshops, where 290 lads, 556 men, enlisted by direct entry, and 14 officers on a signals course, are being trained in the theory and practice of wireless. *The Times* explains that a wireless operator-mechanic of the highest grade must be a fitter, have a thorough knowledge of all electrical plant used by the R.A.F. and of the generators used in aircraft, be able to wire aircraft for wireless, operate and repair the instruments, and, in addition, be able to send and receive Morse clear or in code. The minimum standard required is reception for five minutes at 20 words a minute with not more than three errors, and to simulate actual working conditions in the air all practice is carried out with a definite amount of interference cutting the received signals. Actually 60 per cent. of the lads fulfilled the conditions, receiving at 25 words per minute. No other trade in the ranks has so many opportunities, and there are always at each entry examination more applications than the establishment at the moment calls for. Each lad receives three years' training.

The Arrangement of Cells in Series and Parallel.—Mr. W. F. Dunton, of Newcastle-on-Tyne, who nearly 20 years ago pointed out that the generally accepted rule for finding the best arrangement of cells in series and parallel, to give the largest current through a specified external resistance, under certain circumstances might be very misleading, observes that the rule referred to has recently been republished, and he agai takes up the cudgels on behalf of his own formula. He says:—

"The problem is to find what arrangement of n cells, in p parallel rows of s cells in series, will send the greatest current through an external resistance of R ohms, when each cell has a resistance of r ohms and an e.m.f. of e volts, n being any given number. Whatever value we give to s, the current will be $es/(R + rs/p)$, $= (esp/r)/(pR/r + s)$; and, since esp/r is a constant (sp being the given number of cells), the current will be greatest when $pR/r + s$ is smallest. But this must be when $pR/r - s$ is numerically smallest; for the squares of these last two expressions differ by $4spR/r = 4nR/r$, and when two variables have a constant difference they must reach their lowest values simultaneously. We are thus led to the convenient and infallible rule that the greatest current will be obtained when s is as near as possible to pR/r."

The old rule says that sr/p (which is the resistance of the battery) must be as nearly as possible equal to R; it may seem that this is simply Mr. Dunton's rule expressed in another way, but the difference becomes clear when the rule is applied to actual cases. He also points out that the greatest current obtainable with a given number of cells may be less than that obtainable with a smaller number—it being understood that the cells are in each case arranged in a battery of the above-mentioned regular form, p parallel rows of s cells in series.

Mr. Dunton remarks that this question of battery arrangement is a comparatively unimportant special case of an important class of functions having the form of $ax/(b + cx^2)$. Such functions occur very frequently in engineering investigations; and he remembers a case in which a serious mistake was made in connection with lightning arresters, through the investigator not being aware that this expression had its greatest value when x was as near as possible equal to b/cx. The fact that this is where the greatest value occurs (with a, b and c constant and everything positive) can be proved in the same way as he proves his battery rule, if the numerator and denominator are first divided by cx.

A Severe Ordeal for a Storage Battery.—In connection with the recent failure of the dam at the Aluminium Company's power station at Dolgarrog, North Wales, we learn that at the time of the flood the Chloride storage battery was submerged in ten feet of water, and stood for over four weeks embedded in mud to a depth of over 6 in. above the tops of the cells. We are informed that although it has not been touched since that period it is still working satisfactorily, and is being charged and discharged in accordance with its normal routine. A certain amount of sand has fallen in through the vent holes of the cells, but this has not affected their working. Such a result is, we should think, without a precedent, and affords a striking instance of Chloride reliability.

Röntgen Apparatus in Sweden.—According to a German report from Stockholm, medical circles in Sweden have complained for a long time past that certain accessories for Röntgen apparatus, particularly tubes, are not obtainable in Europe in the same improved form as in the United States. The production of Röntgen apparatus in Europe is limited to a few firms owing to the existence of an international syndicate agreement, and in particular to the A.E.G. and the Siemens Company, while the sole right of manufacture in the United States is vested in the General Electric Company. The report states that, according to Swedish opinion, the accessories turned out by the American company are better than those supplied by the German firms. But in consequence of the existence of the syndicate agreement it is impossible for the Swedes to import the accessories from the United States, although there is a large demand for them in Sweden. In these circumstances Swedish medical men have presented a petition to the Government asking for the State to expropriate the patents concerned on the basis of Article 17 of the Swedish patent ordinance. The Swedish Board of Trade is said to have supported the proposal.

Venner Stop Watch Test.—We have received a copy of a report by the National Physical Laboratory on the Venner stop watch, a production of Venner Time Switches, Ltd. The instrument was examined in the "pendant up" position with the following results to the nearest 0.02 of a second. After indicated intervals of five and 10 seconds the errors were 0.04 second gain in each case; 20 sec., 0.02 gain; 30, O.K.; 50, 0.02 gain; 100, 0.02 gain; 200, 0.02 gain; and 300, 0.04 gain. The watch was found to run satisfactorily for one hour. A description of this instrument appeared in our columns on April 21st, 1922. It may be recalled that the seconds hand records 10 seconds in one revolution, and that each second division is divided into tenths, the latter measuring about 1/16th in. The minute dial records five minutes in one revolution, and each minute division is divided into sixths, so that each small division represents a complete revolution of the seconds hand.

Whitworth Society.—The third annual commemoration dinner was held at the Holborn Restaurant on Monday, December 21st, the anniversary of the birth of Sir Joseph Whitworth, Bart., with the president, Mr. Wm. Sisson, of Gloucester, in the chair, and about 70 members present. There are now 470 members on the roll. Full information can be obtained from the hon. secretary, c/o Institution of Mechanical Engineers.

Appointments Vacant.—Head of the Electrical Engineering Department, L.C.C. Hackney Institute (£480); lady demonstrator and saleswoman (£182) for the Southport Corporation Electricity Department; electrical engineer for the Cornwall Mental Hospital; electrical engineer and electrical inspector for the Public Works Department of the Government of Bihar and Orissa; assistant electrical engineer for the Singapore Harbour Board ($400 a month, dollar=2s. 4d.). (See our advertisement pages to-day.)

Local Societies.—SHEFFIELD ILLUMINATION SOCIETY.—We have received a copy of the syllabus of this Society for the session of 1926, which shows that an interesting series of lectures and visits has been arranged. The Society has now completed its first year, and excellent progress has been made, the membership being 111.

INTERMITTENT ELECTRIC FORCE.—At a meeting of the Royal Society of Edinburgh recently, an address on "The Intermittence of Electric Force, and its effects on Atomic Dynamics" was given by Sir J. J. Thomson. The theory discussed was that when a body is under the action of electric force, instead of receiving a continuous flow of indefinitely small increments of momentum, the increments it receives are each finite in amount and separated by finite intervals of time, called the time interval of the electric field. For events which last over a large number of time intervals the results are the same as those given by the classical theory of continuous force, but for events which can happen in a very short time comparable with the time interval of the field, an entirely different treatment is required, and the path of an electron in an electric field would not be of continuous curvature, but an irregular polygon with a very large number of sides. The electron staggers about irregularly, not necessarily retracing any previous path, but diverging in a way governed by the laws of probability.

When the number of sides of the polygon is very great the number of paths which differ appreciably from that given by the classical theory is a very small fraction of the whole number, but this is not true when the polygon has only a moderate number of sides. It was shown that the intermittence of electric force would lead to some spontaneous dissociation of a system consisting of electrons and positively charged particles, and that it would also lead to the production of Röntgen rays, when electrons passed near atoms, but that these rays would be very soft unless the electrons moved so quickly that the time they were in the neighbourhood of the atom was comparable with the time interval of the electric field in the atom. Since the time interval gets longer as the strength of the electric field diminishes, the waves will be reflected back at this stage, and thus the energy will be confined to a limited volume. The shorter the period of the waves the smaller will be this volume. This has an important application to light, as it shows that the energy must travel in bundles which do not spread out as they travel through space. This conception simplifies the dual theory of light recently brought forward by the author, as it ensures that the energy of the electrical waves in the unit of light shall be constant as well as the energy of the quantum.

ROLLING MILLS.—Mr. L. Rothera, of the English Electric Co., recently read a paper on "Speed Control in Relation to Modern Rolling Mill Drives" to the members of the West of Scotland Iron and Steel Institute in Glasgow. In the case of a sheet mill, Mr. Rothera showed that an increased rolling speed would increase the power cost and at the same time the output would be no greater. In a section mill, however, higher speed would result in a reduced cost and a greater tonnage output. The use of a higher rolling speed would not, within limits, increase the cost of either mill or drive, but more expensive handling apparatus would be necessary, and this would require to be set off against the larger output.

A Children's Party.—Over one hundred children of employés of the Glasgow Corporation Electricity Department who fell in the war were entertained by the Welfare Department to a Christmas treat last week. Bailie Councillor Dewar, Convener of the Electricity Committee, presented each child with a new shilling. Mr. R. B. Mitchell, general manager, and Mrs. Mitchell were present during the evening, the success of which was largely due to the excellent arrangements made by the committee, with Mr. A. M. Estcourt as secretary.

Large Variable-Voltage Transformers.—Six variable-voltage, single-phase transformers were delivered recently to the Philadelphia Electric Company by the Westinghouse Electric and Manufacturing Company; they are rated at 20,000 kVA each, and are oil-immersed, constituting two banks delivering 60,000 kVA to lines supplying power to Trenton and Bristol, N.J. The transformers will operate delta-connected on the low-voltage side at 13,800 volts, delivering power on star connection at from 69,000 to 76,000 volts. The variable delivery is made possible by four steps embodied in a tap-changing device designed for changing voltage under full load without shutting off the power or interfering with the transmission system or circuit-breakers. It is claimed that these are the largest transformer installations ever placed in operation which include tap-changing under load conditions. The specially designed tap-changing mechanism is mounted in a large steel cubicle attached to the top of the transformer tank at one side. The cubicle is off the ground, and is entered through a door which is locked to prevent the tap settings from being meddled with by others than those in charge. The transformer tanks are more than 15 ft. in height, with an overall clearance, including platform and bushings, of 24 ft. The tanks measure 9 ft. 5 in. in diameter. The two banks are being installed in the Richmond Station of the Philadelphia Electric Company as part of what will ultimately be eight 50,000-kVA generating and transmission units.

Arc Welding a Bridge.—The strengthening and repair of Holt Fleet Bridge spanning the River Severn at Holt, Worcestershire, by means of a special process of electric arc welding is being considered by the County Council as an alternative to rebuilding the bridge. Two French engineers, M. de Boulogne and M. Gueritte, have undertaken to inspect the bridge and to report to the Council on the practicability of applying the process. The Surveyor (Mr. F. C. Gettings) has interviewed the chief engineer for steel structures to the Paris, Lyons and Mediterranean Railway, and inspected work on bridges along that railway.

Research Contribution.—Stepney Borough Council Electricity Committee has recommended the Council to make an annual contribution of £25 to the funds of the British Electrical and Allied Research Association.

A New Electric Vehicle.—The City of Birmingham's Cleansing Department has added to its extensive fleet of battery-driven electric vehicles an unusual type which embodies a new idea in the design of such vehicles. It is a 5-ton tipping wagon, supplied by Messrs. Electromobile, Ltd., and its outstanding feature is the fact that it incorporates the four-wheel drive, each wheel being provided with a 2½-h.p. driving motor. The transmission is through high-ratio compound gearing, the final drive being by means of teeth on a brake drum that forms part of each wheel. Braking is thus provided on each wheel, in addition to the usual form of electric braking operated by the controller. The vehicle marks a new stage in electric refuse-collecting vehicle design and its operation in Birmingham will be watched with interest.

Reduction of L.C.C. Tramway Rates.—According to the *Daily Sketch* a conference of London rating authorities has reduced the rates on the tramway track of the L.C.C. by one half. The L.C.C. claimed that, in view of the heavy losses on the tramways, there should be no rates at all. For the year ended March 31st last the deficiency on the L.C.C. tramways was £286,670. The local rates paid on the tracks amount to over £60,000 a year. It is estimated that the deficiency for 1925-26 will amount to approximately £200,000.

Transmission at 150,000 V.—*Eclairage et Force Motrice* reports that during 1925 the transmission pressure upon the new lines of the Cie. des Chemins de Fer du Midi was progressively carried from 60,000 to 150,000 V. These lines connect the railway company's sub-stations on the Dax-Toulouse line with the source of supply. It was intended to provisionally employ a pressure of 60,000 V, and eventually one of 120,000 V, but it was found that the system, parts of which are designed to carry 100,000 kW, was capable of withstanding 150,000 V. The outdoor transformer stations were supplied by the Cie. Electro-Mécanique. It is suggested that this is the first instance of the use of 150,000-V a.c. transmission in Europe, and it is stated that during tests a pressure of 165,000 V was applied, without any ill-effects, for half an hour.

Institution Notes.

Physical Society of London.—THE DUDDELL MEDAL.—The Duddell Medal of the Physical Society of London has this year been awarded to Mr. Albert Campbell, formerly of the National Physical Laboratory. The medal is awarded to those who have advanced the science of physical measurements by inventing instruments or parts of instruments of novel design. Mr. Campbell has won distinction for many new devices connected with the measurement of capacity and inductance. He was one of the first to introduce coils of small self-capacity, now so largely used in wireless; Campbell's system consists of a number of pancake coils separated from one another by small spaces and held rigidly together.

Mr. Campbell has invented instruments for the measurement of frequency; others, known as wave sifters, for the elimination of particular frequencies; instruments, called microphone hummers, for the production of small alternating currents; and vibration galvanometers for use in measurements employing alternating current. The instrument which has won him greatest fame is the standard mutual inductance, which forms the basis of most of the accurate measurements of inductance in this country. Mr. Campbell is well known for his skill as an experimenter, and has made two determinations of the ohm in absolute units.

Institution of Public Lighting Engineers.—At an emergency Council meeting, held at Leeds, at the termination of the second annual meeting and conference, votes of thanks were accorded to Mr. S. B. H. Langlands, J.P., the retiring president, and Mr. W. J. Liberty, the hon. secretary, and the latter was presented with a cheque on behalf of the Council. Mr. Leon Gaster, hon. secretary of the Illuminating Engineering Society, was admitted as an hon. member of the Institution, and it was confirmed that the third annual meeting and conference should be held in September, 1925, at Newcastle-upon-Tyne, under the presidency of Mr. R. Davison, superintendent of the public lighting of that city.

Institution of Heating and Ventilating Engineers.—PRIZE COMPETITION.—The Council of the Institution is offering prizes for original papers as follows: The Lumby Premium (10 guineas) for the best paper dealing with, or any subject connected with, heating or hot-water supplies; the Sirocco Premium (10 guineas) for the best paper on ventilation and the general application of fans, air washing and conditioning, dust and fume removal, mechanical draught, &c.; and the London Premium (five guineas) for the next best paper on any subject included in the above. The competitor must be either a student attending a technical institute or an assistant actively connected with the business of heating and ventilating in Great Britain and Ireland, and is not a principal or an employer. Papers should be not more than 7,000 words in length, and must be written under a *nom-de-plume*, the name and address of the author, in a separate sealed envelope, to be sent with the paper to the secretary not later than May 1st, 1926.

An Institution of Fuel Economy.—A new Institution has been formed, to deal in a scientific manner with the problem of preparing and utilising our fuel resources with much greater efficiency. This new organisation, which is called "The Institution of Fuel Economy Engineers," was inaugurated at a meeting of experts on Tuesday last week, at the Engineers' Club, London. Among those taking part in the proceedings were Dr. T. Barratt, Prof. Bacon, Mr. W. C. Goodchild (representing Sir Henry Fowler), Dr. R. Lessing, Messrs. E. W. L. Nicol, John Bruce, S.W. Bettoney, J. S. Gander, and A. C. Mahar. The first Council was elected, and it was decided to form sections in different parts of the country. It is hoped to make this new Institution the responsible organisation representing every section of fuel technology throughout the country. The secretary is Mr. H. L. Pirie, and the registered office of the Institution is 29, Sherwin Road, Lenton, Nottingham, pending the opening of London headquarters.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements).

The Canadian *Electrical News* announces that Mr. JAMES MUIRHEAD has resigned from the position of chief inspector of electrical energy for the Province of British Columbia, which he has held for five years, to commence a private consulting practice. Mr. Muirhead was educated at Glasgow University and before joining the British Columbia Electric Railway Co., Ltd., in 1912, was successively with the Glasgow Corporation Tramway Department, the British Thomson-Houston Co., Ltd., Krumos, Ltd., and Bruce Peebles & Co., Ltd.

The French Académie des Sciences has awarded the Gaston Planté prize to M. J. BETHENOD, of the Ecole Supérieure d'Electricité, of Paris, for his work on "The Generation and Utilisation of Alternating Current at High Frequencies."

Mr. ROBERT INGLIS, late chief superintendent, Post Office Telegraphs, Glasgow, was entertained by his former colleagues on the occasion of his retirement and a presentation was made. Mr. David Miller, the new chief superintendent, presided.

Glasgow Electricity Committee is recommended to appoint Mr. J. IRVINE, at present book-keeper under the cashier in the Corporation Electricity Department, to the position of principal book-keeper at a salary of £350 per annum.

Mr. C. HOLMES WAGHORN, A.M.I.C.E., general manager of Walker Vehicles, Ltd., has resigned from that position and will shortly associate himself with another branch of the engineering industry. Letters addressed to him c/o Walker Vehicles, Ltd., Clare House, Kingsway, W.C.2, will be forwarded.

Mr. W. A. BROWN, who has been with the Pirelli-General Cable Works, Ltd., since its inception early in 1915, resigned his appointment as from December 31st, 1925. His private address is 87, Gloucester Road, London, S.W.7.

Mr. J. W. F. THELWALL, Commercial Secretary at Berlin, will be in attendance at the offices of the Department of Overseas Trade from January 4th to 9th inclusive for the purpose of interviewing British manufacturers and merchants interested in export trade with Germany. Interviews can be arranged by writing to the Department, 35, Old Queen Street, S.W.1, quoting Reference 6044 T.G.

Mr. ROBERT BRUCE has relinquished his position as manager of the electrical department of Engineering Supplies, Ltd., London, and has been appointed managing director of the Saxonia Electrical Wire Co., Ltd., of Roan Works, Greenwich, S.E.10.

In the course of his speech at the annual meeting of the Provincial Electric Supply Association recently, SIR HARRY RENWICK, the chairman, referred to the loss that the committee had sustained by the death of Mr. W. L. Madgen. He also mentioned the continued ill-health of the late secretary, Mr. T. W. Cole, who had been forced to relinquish all active work, but who carried with him into his retirement the best wishes of the committee and all who were associated with him.

Mansfield Electricity Committee has recommended the appointment of Mr. JOHN WHITE as electricity showroom attendant at £250 per year, rising by £12 10s. per annum to £300.

Mr. J. C. WESTHOVEN, the newly-appointed Deputy Director of Posts and Telegraphs, Victoria, who succeeded Mr. C. E. Bright, recently retired, took up his duties at the General Post Office, Melbourne, in November.

According to a copy of the *Sydney Morning Herald* just to hand the Sydney Electricity Committee has been discussing matters of management in a manner which reminds us of the controversy which formed the subject of editorial comments in the ELECTRICAL REVIEW for July 24th, 1925, page 123. Some weeks ago Mr. FORBES MACKAY left Australia to take up extended duties on behalf of the Department in London. From the paper now before us it seems that the Lord Mayor submitted to the Electricity Supply Committee in November a proposal that Mr. G. S. BOYD should be appointed acting deputy general manager during Mr. Mackay's absence. Some discussion followed, in the course of which Mr. Alderman McElhone, who took a leading part, said that if the proposal were adopted it would only create discontent and unrest amongst the senior officers of the power house as it entirely ignored precedent and the claims of a senior officer (Mr. Vine Hall). Mr. Maling, the acting general manager, is reported to have stated, in reply to questions by aldermen, that he had made the recommendation to the Lord Mayor that Mr. Boyd should be appointed to the position, though, on a previous occasion, Mr. Vine Hall, as senior officer, had acted as deputy general manager whilst he (Mr. Maling) was making investigations for the department abroad. A recommendation had been made by Mr. Forbes Mackay that Mr. Vine Hall should be appointed to that position. "But," added Mr. Maling, "I, as acting general manager, am now responsible for the management of the power-house and the department pending the return of Mr. Mackay, and any recommendation that Mr. Mackay may have made on the matter should have no bearing on what I, as acting general manager, now recommend." Later speakers called for the circulation of papers relating to the matter. The Labour aldermen present, being in a majority, forced the adoption of the Lord Mayor's minute, but agreed that the papers asked for should be circulated before the meeting of the City Council. Alderman W. P. McElhone said a great wrong was being done to a very valuable officer of the City Council for party reasons and through pique.

Mr. G. E. SMITH, engineer and manager of the Urban Electric Supply Co., Ltd., Dartmouth, since 1902, has relinquished his position in order to take up business in London. Mr. H. HAROLD, accountant, who has been with the company for 21 years, has been appointed manager.

This winter the demand on the Willesden Council's Electricity Department has exceeded 10,000 kW, and to mark this event the technical staff of the undertaking has made a presentation of books to the chief electrical engineer (Mr. A. W. BLAKE).

Obituary.—DR. T. VON MOLLER.—The death occurred on December 6th, at the age of 86 years, of Dr. Ing. Theodor von Moller, the founder of the electrical firm of K. & Th. Moller Gesellschaft, Brackwede, Westphalia.

DR. C. MICHALKE.—Dr. Carl Michalke, who had been associated for many years with the Siemens-Schuckertwerke, Berlin, and for the last 25 years was head of the company's technological bureau, died recently at Charlottenburg, aged 65 years.

DR. G. KLINGENBERG.—The death is announced from Berlin at the relatively early age of 55 years, of Prof. Dr. Georg Klingenberg, a well-known German electrical engineer and a director of the A.E.G., of Berlin.

MR. F. HANMER.—Mr. Frank Hanmer, joint founder of and for many years sole proprietor of Messrs. Powell & Hanmer, Ltd., of Birmingham, has just passed away.

Wills.—The late Sir BACHE EDWARD CUNARD, who was a director of the Chloride Electrical Storage Co., Ltd., and of the Lanarkshire Tramways Co., left unsettled property £13,123 gross and £12,638 net.

New Companies Registered.

Orion Lamps, Ltd. (210,506).—Private company. Registered December 19th. Capital, £2,000 in £1 shares. Objects:—To acquire the trade mark "Orion," No. 452,717, and to carry on the business of electricians, manufacturers of, dealers in, and agents for all kinds of electric lamps, radio tubes and apparatus, &c. The permanent directors are:—J. Kremenezky, 13, Wasagasse, Vienna 9, electrical engineer; T. R. Martin, 62, Wellington Road, Edgbaston, Birmingham, electrical engineer. No person, other than the first directors, connected with any person, firm, or company engaged in the manufacture of electric lamps, valves, heating and cooking apparatus or similar products, other than Joh. Kremenezky, of Vienna and Budapest, or person, firm, or company under Messrs. Kremenezky's control, shall be eligible to hold office as director or alternate director without the consent of all the directors. Registered office: Eldon Buildings, 15-17, Eldon Street, E.C.2.

Ramsbury Electric Supply Co., Ltd. (210,526).—Private company. Registered December 21st. Capital, £2,500 in £1 shares (1,500 ordinary and 1,000 preference). To adopt an agreement with the Ramsbury Electric Supply Co. for the acquisition of the business carried on by them, and to carry on the business of an electric supply company, &c. The directors are:—H. Smith, 73, Fellows Road, Hampstead, N.W.3, electrical engineer; S. G. Prince, Malt Street, Old Kent Road, S.E.1, electrician (managing director, with £200 per annum as remuneration). Solicitors: Ward and Melliur Smith, 35, Queen Victoria Street, E.C.4.

Pan-Electric, Ltd. (210,545).—Private company. Registered December 21st. Capital, £200 in £1 shares. Objects:—To carry on business as electrical, mechanical, civil and consulting engineers, electrical and general contractors, manufacturers of and dealers in electrical machinery, advertisement signs, signalling, telegraphic, telephonic and wireless apparatus, instruments of precision, &c. The first directors are:—J. E. Cochrane, 4, Lampard House, Royal Hospital, S.W.3; A. R. Greenaway, 35, Pearfield Road, Forest Hill, S.E.23, electrical engineer. Qualification, 1 share. Remuneration as fixed by the company. Secretary: A. B. Ford-Moore.

Western Radio and Supplies, Ltd. (210,419).—Private company. Registered December 16th. Capital, £500 in £1 shares. Objects:—To carry on wireless telegraphy and telephony, and photography business, &c. The first directors are:—C. H. Phillips, 11, Claude Place, Cardiff, engineer; H. F. Phillips, 5, Laytonia Avenue, Cardiff, engineer; R. C. Francis, 37, Westbourne Road, Penarth (all directors of Tressillian Motors, Ltd.). Qualification, 1 share. Remuneration as fixed by the company. Solicitors: Lewis, Morgan, Browne & Haslam, 31, High Street, Cardiff. Registered office: 18, Queen Street Arcade, Cardiff.

Official Returns of Electrical Companies.

Holophane, Ltd. (110,941).—Capital, £105,000 in 100,000 ordinary shares of 1s. each and 100,000 preference shares of £1 each. Return dated October 23rd, 1925. 100,000 ordinary and 60,757 preference shares taken up. £15,207 paid. £50,550 considered as paid. Mortgages and charges, nil.

Synchronome Co., Ltd. (120,465).—Capital, £2,000 in 1,400 ordinary and 600 preference shares of £1 each. Return dated November 4th, 1925. All shares taken up. £700 paid. £1,300 considered as paid. Mortgages and charges, nil.

Electric Supply Co. of Victoria, Ltd. (66,059).—Capital, £325,000 in 175,000 preference and 150,000 ordinary shares of £1 each. Return dated November 26th, 1925. 175,000 preference and 125,000 ordinary shares taken up. £50,007 paid. £249,993 considered as paid. Mortgages and charges, nil.

Yale Electric Power Co., Ltd. (60,493).—Capital, £20,000 in 3,300 preference shares of £1 each and 668 ordinary shares of £25 each. Return dated December 10th, 1925. 300 preference and 668 ordinary shares taken up. £15,300 paid on 300 preference and 600 ordinary shares. £1,700 considered as paid on 68 ordinary shares. Mortgages and charges, £5,567 7s. 9d. (bank overdraft).

Frinton-on-Sea and District Electric Light and Power Co., Ltd. (70,689.—Capital, £10,000) in 7,300 preference and 2,700 ordinary shares of £1 each. Return dated November 17th, 1925. All shares taken up. £10,000 paid. Mortgages and charges, £4,000.

Pacific and European Telegraph Co., Ltd. (36,683c).—Capital, £100,000 in £10 shares. Return dated November 12th, 1925. All shares taken up. £40,000 paid (being £4 per share called up). Mortgages and charges, £66,500.

Western Electric Distributing Corporation, Ltd. (79,057).—Capital, £140,000 in 70,000 preference and 70,000 ordinary shares of £1 each. Return dated October 15th, 1925. 52,655 preference and 54,510 ordinary shares taken up. £107,165 paid. Mortgages and charges, nil. Returns of allotments, made up to December 2nd, 1925, show a further 1,320 preference and 10,250 ordinary shares allotted for cash.

United Weldings and Electrical Co., Ltd.—W. H. Watson, of 29, Brown Street, Manchester, was appointed receiver on December 8th under powers contained in debentures dated March 25th, 1925.

Budleigh Salterton Electric Light and Power Co., Ltd.—Debenture dated December 8th, 1925, to secure £3,000 charged on the company's land at Budleigh Salterton, and the company's undertaking and property, present and future, including uncalled capital. Holders: Branch Nominees, Ltd., 15, Bishopsgate, E.C.2.

Astro Dynamo Co., Ltd.—Debenture dated November 30th, 1925, to secure £800, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: F. U. Y. Weldon, 94, Alderman's Hill, Palmer's Green, N.13.

Paragon Electric Welding Co., Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital, dated December 7th, 1925, to secure all moneys due or to become due from the company to Lloyd's Bank, Ltd.

City Notes.

Reports and Meetings of Electrical Companies. Dividend Results, &c.

British Columbia Electric Railway Co., Ltd.

The annual meeting of the company was held in London on December 23rd, Mr. J. Davidson (deputy-chairman) presiding. In moving the adoption of the report and accounts Mr. Davidson said that in the absence of the chairman, Mr. R. M. Horne-Payne, he would read his speech. The increase in every department of the company's business reflected the general expansion and prosperity of British Columbia during the year under review. (The report showing this improvement was abstracted in our last issue, p. 1026.) During the year over 4½ million dollars had been spent on capital account, mainly for additions to power generating plants, transmission systems, rolling stock and extensions to the light, power and gas systems. It was the policy of the company to keep every branch of the services in a position to meet the requirements of the communities served; this involved looking some distance ahead and making timely provision for the growth of the demand. The Bridge River site mentioned in the report was capable of yielding at least 200,000 h.p., although this would not be developed in its entirety at present. There was no doubt, however, that the expansion of shipping and industry in Vancouver would necessitate an increasing supply of power. It would be noticed that the accounts had been presented in dollars, following the advice of the auditors, who considered that the consolidated accounts should be in the same currency as those of the subsidiaries. Referring to the company's earnings in Vancouver, the chairman said that it had been held that a public utility company was entitled to earn 8 per cent. on its entire capital; taking the whole of the capital employed in the company's undertaking the return earned was only between 5 per cent. and 6 per cent. The report and accounts were adopted, and the retiring directors, Mr. R. M. Horne-Payne and Sir Ernest Harvey, K.B.E., were re-elected. Mr. G. P. Norton paid a tribute to Mr. Horne-Payne, who, he said, had been responsible for the starting of the company 30 years ago. The undertaking had done an immense amount of work and had played an important part in the development of British Columbia.

German Companies.

The report of the *Bank of Electrical Values*, of Berlin, records a net profit of 853,000 marks, permitting of the payment of a dividend at the rate of 5 per cent. on the ordinary shares.

The German newspapers announce that the interim balance sheet of the *Dr. Paul Meyer A.G.*, for the period ended September 30th last, shows a loss of 2,115,000 marks. It is proposed to withdraw the preference shares for 500,000 marks, to reduce the ordinary shares from 2,500,000 to 500,000 marks and then to increase the ordinary capital by 3,000,000 to 3,500,000 marks. The amount thus released will be devoted to writing off the loss and making further provision for depreciation. It is considered that the productivity of the undertaking will be improved if it is possible to carry out a scheme for the relinquishment of a number of unprofitable types of manufactures, simultaneously with the extension of bulk production.

French Companies.

The *Société d'Exploitations Electriques* has decided to pay a dividend at the rate of 17.50 fr. gross per share for 1924-25 out of net profits of 1,943,000 fr.

The *Société de L'Union Electrique* reports that the net profits increased from 49,000 fr. in 1923-24 to 162,000 fr. last year, but it is not proposed to make any distribution.

The *Société Industrielle des Téléphones*, which has declared a dividend at the rate of 50 fr. per share for 1924-25, reports that the multiple automatic exchange at Vichy has been opened for the French Post Office. The works at Calais, although not having had many orders for submarine cables, has yielded satisfactory results, thanks to the production of enamelled wires, which has been established there. At the Clichy works the normal development of the new manufactures has continued and given encouraging results, but a much more serious effort remains to be made in order to bring the works up to full output.

The *Compagnie Générale d'Electricité*, which has maintained its rate of dividend at 70 fr. per share for 1924-25, states that the results were more satisfactory than had been anticipated, having regard to the French financial crisis. The profits were higher by 3,154,000 fr. than in 1923-24, although the production of the industrial establishments on the whole showed a slight decrease. It has been decided to increase the share capital from 75 to 90 millions of francs in order to acquire the undertaking of the Compagnie Générale des Câbles, of Lyons.

Indian Companies.—*Tata Hydro-Electric Power Supply Co.*—The report for the year ended June 30th last records an income of Rs. 52,22,745 and an expenditure of Rs. 21,78,115. After providing for depreciation and writing off special expenditure, there is a balance of Rs. 22,24,053, and to this is added Rs. 38,544 brought forward, making Rs. 22,62,608. From this is distributed a final dividend, making 8 per cent., free of tax, for the year on the ordinary shares and a balance of Rs. 3,77,718 is carried forward. In 1923-24 the ordinary dividend was 7 per cent.

Andhra Valley Power Co.—The total income of the company for the year ended June 30th last was Rs. 54,21,869, and the available balance, after deducting working costs, debenture interest, &c., was Rs. 14,28,011. This is being distributed as follows:—Writing off the previous year's deficit Rs. 4,77,584; writing off other expenses amounting to Rs. 1,00,000; depreciation, Rs. 5,00,000; dividend of 7 per cent. on the preference shares; carried forward Rs. 5,046.

Adelaide Electric Supply Co., Ltd.—The gross revenue for the year ended August 31st, 1925, was £616,353 and the operating expenses and taxation amounted to £309,265, leaving a net revenue of £307,088—an increase of 34 per cent. The balance, after writing off the costs of share issues and providing for debenture interest, &c., was £223,324. From this sum £65,000 was transferred to general reserve (making £215,000), the preference dividends were paid, and a final dividend of 6 per cent. (making 12 per cent. for the year) was declared on the ordinary shares, leaving £924, plus £47,191 (£48,115) to be carried forward.

The A.E.G. Dividend.—It has been left to the American prospectus of the A.E.G., dealing with the issue of a 6½ per cent. loan for the amount of $10,000,000 in debentures, to disclose the fact that the dividend for the year ended with last September will presumably be at the rate of 6 per cent., as compared with 5 per cent. in 1923-24. An abstract from the prospectus further states that the provisional accounts for the past year show a material increase in the net profits and a satisfactory situation.

British Insulated Cables, Ltd.—A statutory meeting of shareholders of British Insulated & Helsby Cables, Ltd., held at Liverpool on December 21st, Mr. James Taylor, J.P. (chairman) presiding, confirmed the resolution passed at the extraordinary meeting on December 4th to change the title of the company to "British Insulated Cables, Ltd."

Newfoundland Power & Paper Co. — Meetings of the debenture holders were called on December 21st to approve of the issuing of further debenture stock. The holders of the "A" debentures agreed to the arrangement by a large majority, but as there was not a quorum of "B" debenture-holders the meeting was adjourned.

Stock Exchange Notices.—The undermentioned have been ordered to be officially quoted:—

British Insulated and Helsby Cables.—333,333 ordinary shares of £1 each, fully paid, Nos. 1,000,001 to 1,333,333.

Mersey Railway.—£281,429 three per cent. "B" debenture stock.

Marconi's Wireless Telegraph Co., Ltd.—The dividend on the 7 per cent. cumulative participating preference shares for the half-year ended December 31st is being paid to-day (January 1st).

Quebec Power Co. — The following dividends are announced:—$1¼ per share on the 7 per cent. preferred stock, and $1¼ per share on the common stock for the quarter ended December 31st.

Stocks and Shares.

MONDAY EVENING.

WE started our review of electrical stocks and shares a year ago by saying that 1924 would deserve to be long remembered as one of the kindest to which proprietors of supply shares had been treated. This followed upon a state of affairs not very dissimilar in 1923. But the 1925 period carried on a good work that has been continuous, now, for three years. The electricity supply industry of London received, last spring, a fresh charter which meant a new extension of life. Investment has appreciated the change, and has bought steadily when shares came in—which was not often in some of the cases. The result is that prices finished 1925 with a remarkably robust appearance, as the following table shows. We add the highest and lowest prices of the year in order to round off the comparisons between December, 1924, and those of to-day:—

ELECTRICITY SUPPLY SHARES.

Ordinary share.	Dec., 1924.	H.	L.	Now.	Rise or fall.
Brompton	1⅞	98/6	32/-	1⅝	— ¼
Charing Cross	45/6	50/6	44/-	48/9	+2/3
Chelsea	37/6	42/-	35/-	42/6	+5/-
City of London	47/6	50/3	45/3	*0/9	+3/3
County	52/6	61/3	51/-	59/6	+7/-
Kensington	10⅞	13⅛	10⅝	13⅛	+2⅛
London	33/6	38/3	32/6	33/6	—
Metropolitan	37/6	40/9	36/6	40/6	+3/-
St. James'	12⅞	15⅛	12⅝	15⅛	+2⅛
South London	2⅛	52/-	41/6	2⅜	+ ⅜
Westminster	11*	47/9	42/-	46/6	+ ⅜

* £5 shares.

Manufacturing and equipment shares have also been a feature of strength in the Old Year. Something like a mild boomlet occurred during the summer, when optimism talked largely of possible increases in dividend. Several satisfactory announcements coloured the rumours, and the companies are known to be going ahead in profitable style. The present Government was expected to benefit cable and electrical equipment companies by tightening up the Safeguarding of Industries Act, but less has been done in this direction than some people hoped. The sensational rise in the price of raw rubber was used as an argument, by certain of the large trade users, for the apprehension that it might handicap the manufacturing firms, but the protest died a natural death: rubber, rubber shares, and equipment shares have gone on rising. Half-a-dozen representative examples in this market are included in the table that follows:—

MANUFACTURING.

Share.	Dec., 1924.	H.	L.	Now.	R'se or fall.
Babcock	2⅝	57/6	47/6	2⅝	— 1/6
British Aluminium	29/6	39/-	27/6	38/-	+8/9
Callenders	2⅛	3⅛	2⅛	3⅛	+ 7/16
General Electric	21/6	30/3	21/3	28/-	+6/6
Henleys	58/9	9⅛	2⅞	70/-	+ 7/16
India Rubber	17/6	23/3	17/3	21/3	+3/9

The engineering branches of trade, with others closely allied to them, have felt the effect of the industrial lassitude in most of the "heavy" departments. Vickers have lately declared for a capital reorganisation, and a writing-off of 13s. 4d. from each £1 ordinary share. Several more companies are expected to follow suit. But these misfortunes have passed over the heads of electrical undertakings, which have suffered only indirectly from the quietude of the Midlands, the North and the West of England.

Turning to the cable companies' stocks, the year has been uneventful. The annual reports and meetings served to demonstrate that cable business is reviving from the effects of post-war depression. The Eastern group maintained its 10 per cent. tax-free dividend on the four ordinary shares and stock in the quartette. Wireless competition is no longer regarded as a reason for nervousness. Indeed, the wireless shares are out of favour; prices are down rather heavily. A few spurts, none of them of any consequence, occurred in this section, but the rubber boom led to sales of Marconi shares in order that the money might be employed in the more popular market. United River Plate Telephones have risen substantially, taking into account the rights that accrued from the new issue of shares. Automatic and International Telephones are also features of strength, and our usual comparative columns bring out these changes:—

TELEGRAPHS, &C.

Stock or share.	Dec., 1924.	H.	L.	Now.	Rise or fall.
Anglo-American Pref	104⅛	106	101½	103	—1⅛
Eastern Extension	17	18⅛	16⅞	18	+1
Eastern Telegraph	172½	178½	169	177½	+5
Globe Ord.	17½	18⅛	17½	18⅝	+1⅛
Great Northern	29⅝	35½	29½	33	+3⅛
Indo-European	32½	45½	31	45½	+13
Marconi	33/9	36/6	21/3	22/6	— 11/3
United River Plate	6⅛	7⅜	6⅜	7⅛	+ 1/16
Western Telegraph	17	17⅛	15⅞	18	+1

The most noteworthy movement in our price-lists is the jump in Brazilian Tractions. The price started 1925 at 58. Upon the increasing traffics, the advantageous movements in the milreis and upon buying said to be for control purposes, the shares have gone ahead by leaps and bounds. Less dramatic, but very noteworthy, has been the rise in British Electric Traction ordinary, which stood at a shade under 100 twelve months ago. The Home Railway group makes a poor showing, and is the one market in the Stock Exchange that has been outstandingly dull for the greater part of the year. Labour demands and dwindling traffics have led to a general weakening of prices, although the final quotations are above the lowest of the year, as these figures illustrate:—

RAILWAY STOCKS AND SHARES.

Stock or share.	Dec., 1924.	H.	L.	Now.	Rise or fall.
Central London Ord....	74	75	64⅜	68	—6
Metropolitan	83	83	64	69	—14
District	86	87	40	47	—9
Underground £10	8⅜	67/-	2	2⅛	— ⅜
,, "A"	9/6	10/9	6/-	7/-	—2/6
,, Inc.	100	102⅜	94⅛	98	—2

The Bank Rate has risen 1 per cent., to 5 per cent., during the year. This had an oblique reference to the return of the nation to a gold standard, but it exercised no more than a transitory influence over Stock Exchange markets. Business has been active, speaking generally, and the prospects for investment and speculative values are demonstrably good. Cordial wishes for a Happy New Year are politely offered to the patient reader of the weekly notes on Stock Exchange markets connected with electrical issues.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom. £	Dividend. 1923.	Dividend. 1924.	Price Dec. 28, 1925.	Rise or fall.	Yield p.c.
Bournemouth and Poole	1	13	14	59/6	—	4 14 1
Brompton Ordinary	1	10	10	1⅛	—	*6 3 1
Charing Cross Ordinary	1	14½	15	2⅞	—	6 3 1
do. do. 4½ Pref....	1	4	4½	17/6	—	5 2 10
Chelsea	1	12	12	2⅛	—	5 13 0
City of London	1	15	15	59/9	—	5 18 1
do. do. 6% Pref.	1	6	6	28/-	—	5 4 4
Clyde Valley	1	8	8	29/6	—	5 8 6
County of London	1	15	15	59/6	−6d.	5 0 10
do. do. 6% Pref.	1	6	6	28/-	—	5 4 4
Edmundson's Ordinary	1	7	7	24/6	+6d.	5 14 8
do. 7% Pref.	1	6	7	21/6	—	6 10 8
Elec. Supply Corporation ...	1	10	10	32/6	—	6 3 0
Kensington Ordinary	5	14	15	13⅛	—	5 13 2
Lancs. Light and Power	1	7½	7½	26/-	—	5 15 5
London Electric	1	10	10	33/6	−6d.	5 19 5
do. do. 6% Pref.... ...	5	6	6	5⅞	+1/16	5 7 10
Metropolitan	1	10	11	40/6	—	5 8 7
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	5½	6	23/9	+1/-	5 1 1
Newcastle-on-Tyne Ordinary ...	1	6	7	29/6	—	6 4 8
do. 5% Pref. ...	1	5	5	18/9	—	5 6 8
do. 7% Pref. ...	1	7	7	24/6	—	5 14 8
Notting Hill 6% Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6% Pref. ...	1	6	6	22/6	—	5 6 8
St. James' and Pall Mall	5	17½	17½	15½	+⅛	5 12 11
South London	1	15	15	2⅝	—	5 18 1
South Metropolitan Pref. ...	1	7	7	1¼	—	5 12 0
Urban Ordinary	1	4	4	18/3	—	4 7 8
do. 6% Pref. ...	1	6	6	18/9	—	6 8 1
Westminster Ordinary	1	15	15	46/6	+6d.	6 9 0
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	1	—	7 10 0
Yorkshire Elec.	1	8		30/6	—	5 5 0

HOME RAILS.

Central London Ord. Assented	Stock	4	4	68	+1	5 17 8
Metropolitan	,,	4	5	69	—	7 5 0
do. District	,,	2½	3½	47	—	7 9 4
Underground Electric Ordinary	10	Nil	Nil	2¼	—	Nil
do. do. "A" ...	1/-	Nil	Nil	7/-	—	Nil
do. do. Income	Bonds	6	6	98	—	*6 2 5

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	103	—	5 16 6
do. Def.	,,	1½	1½	24⅜	—	6 0 8
Automatic Telephone	1	3	3	51/3	—	2 6 10
Chili Telephone	5	6	6	6⅛	—	*4 7 0
Cuba Sub. Ord.	10	5	5	6⅝	—	7 8 2
Eastern Extension	10	10	10	18	—	*5 9 7
Eastern Tel. Ord.	Stock	10	10	177½	—	*5 12 8
Globe Tel. and T. Ord.	10	10	10	18⅝	—	*5 6 8
do. do. Pref.	10	6	6	11	—	5 8 4
Great Northern Tel.	10	22	22	33	—	6 13 4
Indo-European	25	7	8½	45½	—	*4 13 5
Marconi		10	10	1¼	—	9 17 10
Marconi Marine	1	10	7½	7	—	8 11
Oriental Telephone Ord. ...	1	12	12	42/6	—	*5 12 11
United R. Plate Tel.	5	8	8	7⅞	—	5 3 3
Western Telegraph	10	10	10	18xd	—	*5 11 1

HOME AND FOREIGN TRAMS, &C.

Anglo-Arg. Trams First Pref. ...	5	6½	6½	8½	—	8 9 2
do. do. 2nd Pref. ...	5	6	6	8⅛	—	9 8 2
do. do. 5% Deb. ...	Stock	5	5	73½	—	6 16
British Electric Traction Ord. ...	,,	6	6	119½	−½	5 0
do. do. 6% Pref. ...	,,	6	6	105	—	5 14 3
Brazil Traction	100	4	4	84½	+1½	4 14 8
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	85½	—	5 17 0
do. do. Preferred	,,	96/-	96/-	102½	+1	*4 13 2
do. do. Deferred	,,	120/5	120/5	124½	+3	*5 4 5
do. do. Deb.	,,	4½	4½	77	+1	5 10 5
Lond. & Sub. Trac. 5% Pref. ...	1	2½	Nil	3/6	−6d.	Nil
London United Tram. Deb. ...	Stock	4	4	43½	—	9 3 4
Mexico Trams, 5% Bonds ...	—	5	5	61½	−1	8 2 3
Mexican Light Common ...	100	Nil	Nil	21½	—	Nil
do. Pref.	100	Nil	Nil	61½	—	Nil
do. 1st Bonds ...	—	5	5	70½	−1½	7 1 10
Yorkshire (West Riding) ...	1	5	—	18/9	—	5 6 8

MANUFACTURING COMPANIES.

Babcock & Wilcox	1	12	12	51/3	—	*4 13 4
British Aluminium Ord.	1	5	10	38/-	—	5 5 3
British Elec. Transformer Pref.	1	Nil	7	1	—	...
British Insulated Ord.	1	15	15	2¾	—	5 9 1
Brush Ord.	1	10	10	27/-	+9d.	7 8 2
Callenders	1	15	15	3⅛	—	4 12 4
do. 6½% Pref.	1	6½	6½	23/9	—	5 9
Crompton Ord.	1	Nil	Nil	16/3	—	...
Edison-Swan	4/-	10	10	9/-xd	—	4 9 0
do. 5% Deb.	Stock	5	5	85	+1	5 17 8
Electric Construction	1	10	10	33/6	—	6 3 0
Enfield Cable, Pref.	1	7½	7½	1¼	—	6 0 0
English Electric	1	5	5	18/6	−9d.	5 8 0
do. do. Pref.	1	6	6	21/-	—	5 14 3
Gen. Elec. Pref.	1	6¾	6¾	23/6	—	5 10 8
do. Ord.	1	5	7½	28/-	+6d.	5 7 2
Henley	1	15	16	3⅜	—	4 11 5
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	5	5	1⅞	—	*4 14 1
Johnson & Phillips	1	10	10	56/3	+1/9	3 11 1
Met-Vickers, Ord.	1	8	8	27/-	−6d.	5 18 6
do. Pref.	2	8	8	2⅜	—	6 14 9
Siemens Ord.	1	—	7½	34/3	+2/3	4 7 7
Telegraph Construction	12	20	20	27	—	*4 9 0

*Dividends paid free of Income Tax.

Electrical Wiring Installations.

A Comparison of Systems and an Analysis of their Costs.

By I. SCLAR, A.M.I.E.E.

(*Abstract of Paper read before the* DUNDEE SUB-CENTRE *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE paper deals, in an unbiased way, with the commonest systems of electrical wiring and present practice, whilst the figures refer to average installations; there will be cases, of course, where the figures instanced will be well out, but a comparison of some of the merits claimed by the advocates of the various methods shows how the different systems affect the cost of wiring in practice.

The importance of the subject cannot be too greatly stressed, and insufficient consideration has been given to this subject, at least in proportion to the amount of capital, labour, and other direct and indirect interests involved in the electrical installation industry, and other industries depending upon it, and to the proportion that all these interests bear to the whole electrical industry. It is due to the want of this consideration and discussion that the electrical installation side has not advanced so much as other sections of the industry; though great forward strides certainly have been made, they are not in keeping with the large volume of business being done, or what has yet to come.

I agree that there is a lack of " push " about the contractor, but am of the opinion that there is a greater lack on the side of the electricity supply authority, in view of its more fortunate position; it usually has a monopoly of the goods it has to sell, which are all of the same type and class, so there is no quality competition. It can ascertain the exact cost of the one commodity it has to sell, whereas the contractor very seldom gets two jobs alike, and practically every estimate job contains elements of risks which affect the profit he has aimed at. However, we all agree that a lot more can be done by co-operation. When comparing the permanency of one system against another, the fact of the matter is that most installations have not been in existence long enough to enable reliable judgments to be made.

I have based my costs on the latest issue of the I.E.E. wiring rules and on standard materials at the standard trade prices ruling at the beginning of November. The I.E.E. rules may not be agreed with in their entirety, but they have common sense and sound principles which will make themselves recognised, through time, as a sure foundation for reliable work. If you demand a good article in sufficient quantities you will get it as cheaply as an inferior article. Permanency and upkeep are often lost sight of when comparing prices. The average life of a building, even of ordinary brick construction, is reckoned to be between 75 and 100 years, and if the electrical wiring installation is to last that time, a sound job must be made. It behoves us to take more care in the selection of a wiring installation, for permanency is often given too little consideration and in new building work our sense of proportion regarding costs is often misdirected.

The electrical installation costs for a new building may vary from about 3 to 10 per cent. of the total cost of the building. Taking 6 per cent., the difference between a good installation and an indifferent one may be, say, one-third of the price of the installation, only about 2 per cent. of the total cost of the building. Supposing the money is borrowed at 5 per cent, then a 2 per cent. difference would be, say, £20 on a £1,000 house, and the interest on this would be 20s. per annum; it is quite easy to run up a bill of 20s. a year on repairs of an inferior installation, as contractors cannot give much for £1 nowadays. Again, the depreciation on a cheaper installation will be at much greater rate.

In some housing schemes at the present time the cost of the usual installation per house is about £8 to £10 for the average type; supposing by cheaper and often admittedly less reliable methods of wiring we were able to reduce this cost to £5 per house, the actual saving in interest would only be about 5s. per year, which will hardly repair a broken flexible. The cry for cheaper installations is an exaggerated one, and we often hear the high initial cost of the installation blamed as being the means of allowing other sources of illuminant to be installed. The probable difference between a gas installation and a good electrical one is perhaps about two per cent. of the cost of the building, and when the advantages of electricity are taken into consideration this difference should never deter the installation of electricity.

The probablity is that the responsible party has been slow in pushing home the advantages of electricity, and I would say the supply engineer is entitled to do a greater share of the propaganda work as he stands to gain something if the deal is brought off. We don't seem to have enough confidence in the thing we are selling; contractors and supply engineers should act as if gas was out of it altogether. Gas companies are beginning to realise that they are fighting a losing battle; a great gas-mantle manufacturing firm is advertising electrical radiators. We may know the advantages of electricity, but we do not know the disadvantages of gas, and I would suggest that everyone connected with the actual sale of the commodities " electricity " and " electrical installations," should live a double life for a time.

" Safety-first " means the adequate earthing of all appliances and the easiest and most automatic way is to make use of the outer sheathing of an " earthed " system. This deals a severe blow to " insulated " systems, in that to conform to latest regulations an earth conductor is required to be run throughout the whole system. The only practical way to do this is to have an extra wire run under the insulated casing parallel with the current-carrying conductors, which, of course, adds considerably to the cost of the system, to say nothing of the danger of non-continuity at joint boxes, switches, &c., and the labour involved in making such an earth wire continuous. Earthing each appliance to the nearest earth-connected body, actually at the point where such earthing is essential to conform to regulations, would be impracticable, unreliable, and probably unsightly. The difficulty might be got over by using insulated switches and appliances, but there is a much greater factor of safety with a switch in a bathroom whose metal non-current-carrying parts are earthed, as surface leakage due to moisture would take the earth path before the comparatively higher resistance path of the human body.

The point I want to emphasise is that one might be able to run much longer with a faulty installation where the covering of the wires is insulated from earth-connected bodies, than with a system of insulated wires with an earth-connected enclosed covering. Accidents have occurred with cab-tire trailing cables in collieries, with an earth wire actually incorporated in the cable itself, due to a damaged live conductor charging some apparatus with fatal results. If the earth conductor had taken the form of an outside flexible metallic tube, the danger would probably have made itself felt and would have been removed.

A cable with a separate earth wire is not as safe as a cable with an enclosed surrounding earthed tube. As regards fire risks, there is always the danger of open sparking with the insulated system which might not be present with the enclosed earthed systems.

Is conduit or the lead-covered cable easier to make continuous so far as the earthing goes, apart from the extra mechanical protection of the one which is agreed upon? I recently carried out tests with the following result :—

Resistance per 1,000 yd. of lead sheathing = 8 ohms for 3/.036 twin cable.

Resistance per 1,000 yd. of h.g. welded ¾-in. enamelled conduit = 1.16 ohms.

Resistance of standard coupling for ¾-in. conduit = 0.0015 ohm, screwed tight and clean.

Resistance across a universal box, not B.E.S.A., = 0.003 ohm.

Tube was tapped into box at each end for about ½ standard length of thread to B.E.S.A. specification.

Resistance of conduit to an adaptable standard square box when connected by means of standard lock-nuts at each side of the box = 0.0035 ohm, but when threaded into the box = 0.002 ohm.

Resistance across tinned-brass joint box with 3/.036 cable and the bonding tightly made = 0.001 ohm.

Very erratic results could be obtained, as very much depended on the tightness of the threads and whether the enamel was properly scraped off. The tests on the conduit were carried out without cleaning the threads, just as the boxes and tubes are supplied from the makers and as they would be used by the average workman. I found that it was much easier to get consistent results across the lead-covered cable boxes, and that even a fairly slack connection gave practically the same resistance as a tight one, due to the clean contact with the lead; therefore, it seems easier to get better bonding at boxes with lead cable than with conduit, and a lot of the cry about bonding at boxes is exaggerated.

The resistance of the lead is about seven times that of conduit, but taking into consideration the greater resistance at couplings, inspection boxes, &c., for the same length of runs and with the same amount of care in both cases, the resistance of the bonding of the conduit job should be about half that of the lead-covered one, which means that with the same fault resistance in both cases there is more probability of the fuses blowing quicker with conduit than with the lead-covered system. Again, lead cable sheathing has a lower melting point than conduit, say about 1/5th, and therefore there would be a greater factor of safety against fire, especially in favour of conduit.

In order to form a basis for the comparison of costs, most installations can be split up thus :—

Part of installation.	Average proportion of cost.
1. Mains and sub-mains	5 per cent.
2. Lighting and switch points, lighting and heating plug points, *wiring only*, no switches, plugs, &c.	35 ,, ,,
3. Main and sub-main switches	4 ,, ,,
4. Main and sub-main distribution boards	6 ,, ,,
5. Branch switches, plugs and sockets ...	15 ,, ,,
6. Light fittings and radiators, &c., also lamps	35 ,, ,,

The above average figures deal with the installations at present being carried out in offices, dwelling houses, and shops, and allow for all the necessary labour. The important point to observe is that (1) and (2) are the only sections where the cost of the installation is materially affected by the system of wiring employed. The actual "wiring" cost made up of items (1) and (2) ranges between 20 and 50 per cent. of the total cost of the installation. The lower figure is applicable to high-class installations where there are many special plugs, switches, and fittings; the higher figure is probably a maximum for 90 out of 100 complete installations and refers to the very humblest, that is, the housing-scheme type, where the very plainest of fittings and shades are installed. Theatres, hospitals, schools, &c., where it would be dangerous if too many lights in one section failed at the one time, often require special consideration, and the more lights that are fed from each way to the board, so will the cost of the wiring be cheapened, but I may suggest that this cost is not affected to such great proportions as is often imagined. I have often found .003 cable specified by engineers, with the consequent extra expense of larger tubes, &c., for installations where the .002 size would be ample, and I can only conclude that this has been done through force of habit and not because of any advantage likely to accrue. Mains for lighting are regulated by their distance from the supply point and the total rating, and it is safer to assume that a diversity factor should not be taken into account and that the total loading may be on all at once. In the case of heating mains, there is less probability of all the radiator plugs being connected at any one time, and discretion can be used to cut down the size of these mains.

In most cases the mains do not form a great proportion of the total cost of the wiring, and it is cheaper to increase the size of the mains than to try and get over difficulties of voltage drop by increasing the section of the cables to the actual outlet points. For heating probably a 2-kW heater is the minimum and on a 250-volt circuit such a heater will take 8 amps., so that we are really restricted by the I.E.E. regulations to a maximum of two such heater points on the one circuit. We would probably find that a good policy here would be to use a 7/.036 cable to the first point and loop a 7/.029 cable to the next one in the same run.

Is it really necessary to keep all heating and domestic circuits separate from the lighting circuits, especially in view of a tendency to adopt one tariff for all purposes? A fuse to protect a 2-kW radiator is of no use to protect a lamp, and the smaller cables and flexibles to the lights, if they did not actually fuse, would heat up sufficiently to render their insulation unreliable for future use. However, neglecting safety, is there really any claim as regards a large saving in cables?

There will be a saving in mains, for the same mains that feed the heaters could feed the lights, though in practice this might not amount to much, as the actual cost of mains to a fuseboard is about 5 per cent. of the total cost. The proportion of cost of heating means to lighting mains is as 2 to 1 on an average, so that if we cut out the lighting mains and do not proportionately increase the heating mains, the saving in mains will only amount to about 2 per cent. of the installation total cost. In practice, in installations which might show considerable saving in mains (due to long runs) on the one main idea, it would be better for the sake of voltage regulation to keep the mains separate. To loop off the heating plugs, or to run the heating-plug circuits in the same direction as the lighting points, usually will require more wiring than feeding, say, 10 lighting points from one circuit and keeping the lighting away from the heating plugs. Again, to make provision for the future looping of heating plugs more heavy wiring would be required than would be necessary if we just wired for those heating plugs wanted at the time. Also the total first cost would be increased, and the object of the system would be defeated In this matter we are in a quandary, for if we want to conform to the I.E.E. regulations we should not connect more than two heating points, so that we could never reap the full benefit of the one circuit for heating and lighting. Though it looks all right on paper, in practice it turns out very different, for the reason that a house is built more or less in the form of squares, and not in one long line like a street.

While on the question of saving, a considerable one is gained by the elimination of the "drop down" to switch level; by using a ceiling switch we could save 40 per cent. on each light and switch point, or from 10 to 20 per cent. on the cost of a complete installation. On a housing scheme this method would save about 25 per cent. of the cost of the installation.

We will now compare the conduit, lead-alloy flat-twin and three-core, and flat-twin and three-core tough-rubber systems. There are many classes of conduit, which fact materially affects the cost and efficiency, but we will adhere to the heavy-gauge screwed type. The chief advantage of a conduit system is the good mechanical protection afforded, and the chief disadvantages are condensation, rusting of the conduit itself, and the supposed high initial cost due to the greater amount of labour required in erection. Is the extra mechanical protection as necessary as it is made out to be? It would be interesting if we could arrive at some idea of the amount of damage done by nails or other careless handling to the other systems, which might have been prevented if they had had added protection equal to that of conduit. It is quite possible for an installation to test all right after completion, though it may have been damaged in erection and develop annoying faults later on. In this respect tough-rubber cable would have the advantage over lead. Condensation is greatly exaggerated, and where such faults have occurred it is more than likely that the system has been installed in an unsuitable situation where special provisions should have been made to begin with. In 99 cases out of 100 condensation is not likely to trouble average dwelling houses, offices, and other type of building.

Conduit usually calls for a greater amount of labour in erecting, but many of the so-called labour-saving, surface, lead-covered and tough-rubber systems really involve more labour than a conduit system. In fact, I will go so far as to say that the conduit surface job is the only proper surface job. I favour conduit by reason of its rigidity, as the pipes and outlet boxes support each other in such a way that the actual amount of fixing required is much less than with the more flexible systems.

The trouble with surface systems of the lead and tough-rubber types is the total unsuitability of most of the outlet and joint boxes designed. The chief reason for cable makers designing flexible cable systems is that they want to sell the cable required for these systems, but they would sell more if they advertised less in the exaggerated and ridiculous way they do, and designed practical outlet and joint boxes. There is no need for small joint boxes, as in nine cases out of ten they are hidden, and probably in the tenth case, if it is a surface system, a decent size joint box would not look so ugly in proportion to the many cables leading to it.

There is no need for cable makers to design all kinds of different boxes for the sake of claiming a patent system; they would sell their cable under the same circumstances if we had some sort of regularity in the type of boxes and fixings. The cable makers can combine for other purposes, so why can't they combine once more? If we are to conform to the I.E.E. rules we require an earth wire for the cab-tire cable, so that we will have 50 per cent. more joints to make.

From the following tables assistance may be derived in ascertaining the most economical system for a particular condition :—

Table I. Labour Charges for Wiring Only.

	Conduit.	Lead alloy.	Tough rubber.
(a) *Concealed job—new house in course of erection :*			
Cutting away and making roads ...	20	5	5
Measuring and cutting tube or cable and bending to position	35	10	10
Erecting cable or conduit with necessary fixings	20	25	25
Wiring conduit or cable	10	—	—
Bonding conduit or cable	—	5	—
Making joints	5	15	20
Making good	10	5	5
Totals	100	65	65
(b) *Concealed job—house already built :*			
Cutting away and making roads ...	35	15	15
Measuring and cutting tube or cable and bending to position	45	15	15
Erecting cable or conduit with necessary fixings	35	25	25
Wiring conduit or cable	10	—	—
Bonding conduit or cable	—	5	—
Making joints	5	15	20
Making good	30	10	10
Totals	150	85	85
(c) *Complete surface job :*			
Cutting away and making roads ...	5	3	3
Measuring and cutting tube or cable and bending to position	35	10	10
Erecting cable or conduit with necessary fixings	25	50	50
Wiring conduit or cable	10	—	—
Bonding conduit or cable	—	5	—
Making joints	5	15	20
Making good	3	3	3
Totals	83	86	86

Table II. Material Costs.

(i) *Conduit installation :*		
Conduit	35	
Cable, 600-meg. Association	57	
Boxes and saddles, &c., including switch and plug boxes, ceiling boxes, &c., all tapped for necessary switches and accessories	8	
Total	100	units.
(ii) *Lead-alloy system :*		
600-meg. Assoc. cable, twin and three-core...	78	
Boxes and fixings, bonding clamps, &c. ...	3	
Wood blocks, wood switch and plug blocks, &c., all bored and ready for accessories ...	2	
Protective sheathing at switch runs to I.E.E. regulations	7	
Total	90	units.
(iii) *Tough-rubber cable :*		
Cable, 2- and 3-core, with earth wire ...	104	
Boxes and fixings	2	
Wood blocks, &c., as before	2	
Protective sheathing	7	
Total	115	units.

Table III. Summary of Costs.

(i) *Concealed installation—house in course of erection*:

	Wiring labour.	Wiring material.	Total cost of wiring.
Conduit	100	100	200
Lead alloy	65	90	155
Tough rubber	65	115	180

(ii) *Concealed job—house already built*:

	Wiring labour.	Wiring material.	Total cost of wiring.
Conduit	150	100	250
Lead alloy	85	90	175
Tough rubber	85	115	200

(iii) *Surface job*: (*deduct* 6 *units from lead-alloy and tough-rubber for less protective covering*):

	Wiring labour.	Wiring material.	Total cost of wiring.
Conduit	83	100	183
Lead alloy	86	86	172
Tough rubber	86	111	197

Assume, for discussion, that the total cost of the rest of the compl te installation is 300 units; then in the first case:

	Wiring.	Remainder of job.	Total cost.
Conduit	200	300	500
Lead alloy	155	300	455
Tough rubber	180	300	480

and thus the saving by using the cheapest method in place of the dearest is 9 per cent. In the second case:

	Wiring.	Remainder of job.	Total cost.
Conduit	250	300	550
Lead alloy	175	300	475
Tough rubber	200	300	500

which shows the saving by using the cheapest method in place of the dearest to be barely 14 per cent., whilst in the third case:

	Wiring.	Remainder of job.	Total cost.
Conduit	183	300	483
Lead cable	172	300	472
Tough rubber	197	300	497

indicating the tough-rubber cable to be the dearest in this case, and the cheapest system is only 2 per cent. cheaper than conduit. In the case of straight runs for long lengths of mains, or in large buildings served by large single units, the conduit system might work out considerably cheaper than any of the flexible systems, as the erecting and bending items of the work would be considerably reduced.

The above figures show that the conduit installation is more proportionately expensive than the others for the house already built where we want to hide most of the work; flexible systems are best employed on installations like these. The tough-rubber system, even allowing for an earth wire, is not very much dearer than the lead-alloy system, and manufacturers would be well advised to produce a suitable cable incorporating an earth wire. Such cable might require to be more durable, as it is in direct contact with the disintegrating forces, whereas v.i.r. cables have the added protection of conduit or lead sheathing.

As present practice goes, there is really very little difference in the final price of the installation, no matter what system we use; this being the case, we should aim for the best possible. The conduit system is too rigid and affords rather too much protection; the lead-alloy system is too flexible and not sufficiently protected; and the tough-rubber system (though made with more durable insulation) is not sufficiently protected and not as safe as the enclosed earth-conductor system. Therefore, an ideal system would be, say, a twin or three-core cable insulated with tough-rubber, and protected with galvanised layers of thin steel tape wound spirally, which armouring would in turn be protected with tough-rubber. Such a cable should be round, instead of flat, as the former shape is easier bent, handled, connected to fittings, and less liable to become twisted or kinked. It would be less flexible than a lead- or tough-rubber covered cable, but that is what is required, and yet more flexible than conduit. However, such a cable would be fairly expensive, but I think it would be suitable for a greater number of situations than any of the separate systems, and in view of a greater demand its price might come down to an economical level.

We all want cheaper installations, but we must not let that demand be conceded at the expense of efficiency and quality; there is a limit to simplicity, for very often the simpler an installation is, the less efficiently will it be carried out. If every Tom, Dick, and Harry is to carry out wiring work, contracting will deteriorate.

The electricity supply side does not assist the installation side of the industry as much as it ought to, and often retards it by silly pets and regulations. What is considered safe in the one town should surely be as safe in another! If power supply authorities' technical staffs cannot agree amongst themselves as to what is safe, how can they expect the half-savage, poor, uneducated contractor to know? Electricity supply authorities could not do better than work to the I.E.E. rules, and scrap all their own pet ones, as standardisation would lead to an immediate decrease in the cost of installations and do more good than blaming the contractor.

Super-Heterodyne Radio Receivers.

Some Notes on Theory and Practice.

(*Abstract of Paper read before the* JUNIOR INSTITUTION OF ENGINEERS.)

MR. A. E. BOWYER-LOWE, in a recent lecture on the above subject, explained that, while Major E. H. Armstrong undoubtedly did develop the idea, in fact, many had independently discovered the method, the credit for the invention must be given to Lucien Levy, of France, whose English patent was applied for on August 2nd, 1918 (eleven months earlier than Armstrong's), while Levy's French patent is dated August 4th, 1917, whereas Armstrong's date is December 30th, 1918 (seventeen months later). Levy's patent is the property of Standard Telephones and Cables, Ltd. (formerly the Western Electric Co.), to whom a royalty of thirty shillings is due from any amateur who constructs such a receiver, not only from British components, but foreign as well.

The dearth of information regarding super-heterodyne receivers in the British radio journals has resulted in those experimenters who are keen on this method of reception considering the super-heterodyne in terms of American practice, and in judging anything which differs as heresy. For instance, when his company introduced intermediate frequency transformers peaked at 150 kilo-cycles, *i.e.*, 2,000 metres, it received numerous letters pointing out that this must be a printer's error, as in the various writers' experience 30, 40, or 50 kilocycles should have been the wavelength chosen.

Theoretically we might choose any convenient frequency or wavelength for the beat note, or intermediate frequency, but there are practical limitations and several schools of thought on this point.

When dealing with super-heterodyne reception we have to think in kilocycles instead of wavelengths in metres, and any conversion table shows that the increase in frequency is not directly proportional to the decrease in wavelength, but increases very rapidly as the wavelength is shortened, a very important fact to remember. For instance, between:

200 and 250 metres there is a difference of 300 kilocycles
400 and 450 ,, ,, ,, ,, 83 ,,
550 and 600 ,, ,, ,, ,, 45 ,,

We change the frequency of the incoming signal (usually shorter, *i.e.*, greater wavelength) in order to use high-frequency amplification to better advantage, and if we were receiving one definite wavelength only, such as c.w. Morse signals, we could use transformers very sharply tuned so as to pass that wavelength only; but as we are mostly concerned with telephony where, in addition to the fundamental wavelength, we have to pass the side bands as well, transformers must be so designed as to pass from 5 to 9 kilocycles either side of the fundamental in order to avoid distortion. Now, while 5 kilocycles either side of 300 metres covers a wavelength range of 298½ metres to 310½ metres, or 13 metres, the same width of side bands at 1,000 metres gives a range of 34 metres, while at higher wavelengths still the ranges are:—

at 4,000 metres the range is 540 metres
at 7,000 ,, ,, ,, 1,750 ,,
at 10,000 ,, ,, ,, 3,450 ,,

Therefore, at the shorter wavelengths it is possible to use transformers which are more sharply tuned than when the higher wavelengths are used; in fact, it is difficult to make a good transformer at 30 kilocycles which should be sufficiently broadly tuned to eliminate distortion.

Unfortunately while it is theoretically possible to obtain higher amplification with longer wavelengths than with short ones, the large amount of wire that is necessary to obtain the required inductance results in a bulky and expensive transformer, so that the size of wire is usually cut down to a minimum, resulting in a loss due to high-frequency resistance and decreased amplification.

A partial solution to this difficulty was the introduction of steel cores which, by increasing the inductance, allowed of less wire being used, but such cores flatten out the tuning too much unless the wavelength is increased to a point where the flattening just covers the side bands, somewhere in the region of 30 to 50 kilocycles. At these frequencies amplification should be good, but steel cores are responsible for very great hysteris losses which not only create distortion of another kind, but cut down the amplification which theoretically should be possible. There is also the danger that the amplification curve may overlap into the audible frequencies and give rise to background noises.

Americans apparently do not mind distortion or noisy back-

ground so long as they can get distance, but this kind of reception does not find much favour here. The air-cored transformer was the only one possible under the circumstances, the choice of wavelength being the next consideration. We can set up a beat note by heterodyning the signal with a frequency either longer or shorter than the original, and as a consequence we shall be able to tune in a given station at two points on the oscillator dial. Using 30-kilocycle intermediate transformers these two points are very close together and it often happens that two stations are brought in together owing to the upper oscillator setting for one station being the lower setting for another. As we go lower with the intermediate frequency, however, the distance apart at which the same station comes in increases until at 143 kilocycles we have to move the dial through half its travel before one station appears a second time. At 143 kilocycles it is possible by careful design to obtain very high amplification, partly due to the fact that we can use comparatively heavy gauge wire, thereby lowering the high-frequency resistance, and partly due to the fact that the distributed capacity of the winding is low.

It is essential that the various transformers in a set be matched so as to pass the same band of frequencies, and at the lower frequencies this is a comparatively easy matter, because it does not matter within a few hundred metres exactly where the peak is, but as the frequency is raised matching assumes very much more importance and militates against the mass production methods of our transatlantic friends, as with high-amplification h.f. transformers it is a physical impossibility to ensure that every one shall peak at the same frequency; consequently every transformer has to be very carefully measured for frequency and sets sorted out which are alike, ordinary methods of measuring wavelengths not being sufficiently accurate.

After having taken all this care in matching it is essential that the wiring shall be carefully done, and it is necessary that the intermediate valves and second detector be matched for interelectrode capacity, the first detector be sensitive, and the oscillator valve capable of oscillating strongly without excessive plate current; further, and equally important, they must be free from noises of their own. The generally expressed opinion in America that any oscillator will do, is not borne out in the author's experience, as many types give rise to troublesome harmonics, involving the same stations appearing twice for each strong harmonic, which trouble is also apparent when using a combined detector and oscillator; in fact, the latest development of Major Armstrong uses the second harmonic of the oscillating detector valve to beat with the incoming frequency to provide the intermediate frequency.

Mr. Lowe found that as the plate voltage on the first detector valve was reduced the receiver became more sensitive and actually would operate quite well with no plate voltage at all, but subsequently he joined the plate of the first detector to the grid-filament circuit of the oscillator, which provided enough plate voltage, although alternating, and also serves to couple the two valves together, dispensing with the coupling coil.

He later found that this method was the same as that used by R. E. Lecault, under the name of "Ultradyne," who says that the incoming signal "modulates" the radio frequency from the oscillator, but the actual operation is the same as any standard superheterodyne, the main difference being the absence of an underlying direct current on the detector plate. Because the energy of the oscillator is fed into the plate circuit of the first detector instead of into the grid circuit, this method radiates to a much smaller amount than the ordinary method and certainly is distinctly more sensitive, especially on weak signals.

The output of the first detector to the intermediate frequency transformer is dependent on the product of the signal voltage and the voltage generated by the local oscillator, so that it is important that the oscillator be as good as it is possible to make, and that the frame aerial circuit should be of low resistance and free from losses. Stations up to three or four thousand miles can be received on a frame aerial only and distant reception seems limited only by the amount of noise present in the ether. Any superheterodyne which requires the use of an outside aerial is falsifying its title.

In answer to questions raised during the discussion which followed the lecturette, Mr. Bowyer-Lowe made it clear that the super-heterodyne set was not the type to use for local reception, nor could it be expected to give reproduction which would be considered entirely undistorted by a critical ear; it was purely for long-distance reception, for operating a loud speaker practically free from distortion, and without interference.

Magnetic Sheet Material.

Power Losses at High Flux Densities.

By C. E. WEBB, B.Sc.(Eng.), A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

AT the present time there is a marked tendency amongst designers of electrical machinery to employ higher flux densities in electrical sheet steel than have been customary in the past, and, in consequence, to demand guaranteed figures for the total power losses due to hysteresis and eddy currents at correspondingly higher densities. It is therefore a matter of increasing importance to obtain reliable and accurate knowledge of the way in which the power losses vary with the flux density at high densities, particularly in the special brands of sheet material which are now so extensively employed.

Of the two components (hysteresis and eddy currents) of which the total loss consists, the hysteresis loss is usually the more important, and is also the one concerning the law of variation of which there is more uncertainty. There is general agreement as to the validity of Steinmetz's empirical law that—Hysteresis loss in ergs per cm^3 per period$=\eta B^x$, where x is a constant index for any given material, having a value of approximately 1.6 for flux densities between about 4,000 and 10,000 c.g.s. units; but at higher densities surprising differences between the results of different investigators appear to exist, as is made evident in the author's brief survey of some of the principal papers bearing on the subject.

Some investigators find Steinmetz's law to apply closely up to the highest flux densities at which tests could be carried out, whilst others record more rapid variations of hysteresis loss with B in the region of B=10,000—16,000. The extent of the departure from Steinmetz's law also varies considerably, some observers finding a maximum exponent of approximately 2 and others obtaining values as high at 3.2.

In the paper a series of tests (both by a.c. and ballistic methods, carried out at the National Physical Laboratory) on a wide range of sheet materials is described, the results of which appear to confirm the increase in the exponent of B in the expression for the hysteresis loss at values of B between 10,000 and 15,000. They also show comparatively little difference between the various specimens of sheet material tested.

The construction of a new Lloyd square for tests at still higher flux densities, and a further, more detailed, series of tests (both a.c. and ballistic) on a representative specimen of each type of material, making use of this square, are then described. These tests were carried up to B=17,000 or 18,000 and, while confirming and extending the previous results of increased exponents of B for values up to 16,000, indicate a rapid decrease in the exponent at the highest values of B employed.

The test specimens were provided by Messrs. J. Lysaght, Ltd., and comprised samples of lohys, special lohys, high-resistance and medium-resistance grades. To summarise the conclusions deduced from the results recorded, it has been shown that:—

(1) In all the principal types of commercial sheet material in use at the present time, the rate of increase of the hysteresis loss with B is considerably greater at flux densities above B=10,000 than is indicated by Steinmetz's law, or than appears to have been generally realised. In most specimens over a small range in the neighbourhood of B=15,000 the variation is as rapid as the 2.5th power of B, and in some cases it exceeds the 3rd or even the 4th power of B.

(2) Above about B=16,000 the rate of increase falls off very rapidly and drops again to the 1.6th power or even lower.

(3) The eddy-current index at high flux densities is fairly constant and generally rather less than 2.

(4) The apparent values of hysteresis and eddy-current losses in ordinary commercial sheet material depend to a considerable extent on frequency. Experiments not recorded in the paper indicate that this is due to non-homogeneity of the sheet. These effects do not appreciably alter the exponents observed.

Discussion in London.

Mr. H. S. HOLBROOK commenced the debate with the remark that no one had hitherto explored the subject to the extent that the author had done. He explained that American and Continental manufacturers ran their transformer cores at over 20 per cent. greater flux densities than was customary in this country, and so they were able to produce smaller and cheaper plant; therefore, the paper was of practical value. Scale on alloy steels was one of their greatest troubles.

Mr. G. S. MARRIS, who was understood to say that he had been carrying out similar experiments at low densities, pointed out that in the subject of magnetisation so much was of an empirical nature that one hesitated to abandon anything which might be a guide. The author had shown that the Steinmetz

law was applicable only within the range for which it was originally put forward, which fact had been emphasised by the late Dr. Steinmetz himself in one of his books.

Mr. L. SIMMS said that the author had accomplished that which he had set out to do, but he (the speaker) was not so sure that the paper had put the matter beyond all doubt. He referred to the ways in which it was possible that errors might have been introduced in the testing apparatus and, in view of the fact that the coils and transformers were usually run at lower flux densities than rotating machinery, asked the author whether he could assure them that his results were equally applicable in both cases. There was considerable room for similar investigations at audio frequencies.

Mr. H. W. TAYLOR drew attention to the possibility of the use of silicon steels and high-resistance materials increasing the losses; at high densities they might be greater than if ordinary iron had been employed. The addition of silicon to steel, besides introducing advantages, increased the permeability at low density, and that might be the cause of the trouble experienced with increased losses in the completed machine. In this country they did not seem to be able to build machinery of equal quality with the same silicon-content material as was done in America. Continental steel makers gave much closer guarantees than English makers did, and it would therefore seem that the same quality of material was not being obtained in this country.

Mr. LL. B. ATKINSON was of the opinion that the use of the terms "exponent" and "index" was such that the second paragraph of the author's summary of other investigators' results could be read so as to have two meanings. That was the second time they had listened to considerable argument round a formula which would not fit the case; if Steinmetz's law was not true, he would have liked the author to have said so and to have attempted to evolve a new one that fitted the extended case.

Another speaker said the author seemed to know the B_{max} within 5 per cent., which, he thought, was too optimistic.

Mr. C. E. WEBB, in reply, indicated that the results which he had obtained were not meant to be directly applied by the practical man when designing a machine, but were rather a means of determining the fitness of material to be used. Between the limits of $B = 3{,}000$ or 4,000 and 10,000 the Steinmetz law was true, but he had not succeeded in devising a simple formula that would meet the extended case, nor were they likely to do so. Work was in hand on the determination of losses at audio frequencies.

Economic and Industrial Conditions in France.

Development of Natural Resources.

MR. J. R. CAHILL, Commercial Counsellor to the British Embassy, Paris, has furnished a bulky report,* revised to July, 1925, upon economic and industrial conditions in France, to the Department of Overseas Trade.

The introduction to the report presents a general survey of France's industrial power, and it is stated that her immense war losses have now been made good as regards both industry and agriculture, by a system of immigration from surrounding countries. In addition, every effort has been made to improve methods and instruments of production, and in this connection electricity has had a large share. It is noteworthy that the shortage of agricultural labour has been to a large extent compensated for by rural electrical development. The country's water power is being harnessed as rapidly as circumstances will permit, and many schemes have been accorded State support. As regards the supply of raw materials, the country's position has been improved by the acquisition of the Alsace-Lorraine ore, coal, potash and oil fields, and by the usufruct till 1935 of the Saar coal mines. Side by side with development of the northern coal fields, the production of electrical energy has proceeded at a rapid rate, and an appendix to the report gives a very exhaustive review of the activities of the mining companies, especially from the point of view of the production of electric power.

The war-time extensions of plant in the engineering industries have, in many cases, been converted to the production of peace-time necessaries, and are now engaged in efficient mass production. As regards organisation, the main features in recent years have been the enlargement of the units and the tendency towards combination. In the engineering industries several cases of large-scale consolidation exist; in the electrical industry one company runs nine factories, each engaged in the manufacture of a different series of products, and it has large participations in a score of other manufacturing concerns, as well as in many electricity distribution schemes. Two or three other electrical concerns also possess numerous factories and participate largely in distribution. Electrical material manufacturing concerns have also in some cases made working arrangements with steel producers. In addition to the opening of new works in France itself, extensions have been made by many firms into neighbouring countries.

The Electrical Industry.

The report states that the unbroken prosperity that has attended the French electrical industry since the war has been, and is being, fully maintained. This is attributable not only to railway electrification, and hydro-electric and other power developments, but also to the general advance in the utilisation of electricity in farm, factory, and home. The number of communes in France provided with electricity rose from 2,000 in 1911 to 10,000 in 1923, and to-day the number no doubt reaches 12,000. The development would have been more rapid had not many projects been handicapped by lack of funds. Like several other French industries, the electrical material industry is dominated by a few concerns. In addition, it is closely intertwined with undertakings engaged in the production or distribution of electricity, and it has thus secured a great permanent body of buyers of its products. The Thomson-Houston concern has a capital of 300 millions of francs, and it has special arrangements with the firms of Schneider and Jeumont in connection with the supply of railway electrification requirements. In 1921, with two other large electrical concerns, it formed the Compagnie des Lampes, which embraces several of the chief lamp concerns in France and Spain. It has interests, direct or indirect, with numerous electricity producing works, distribution undertakings, electric traction concerns, &c., and it also has close connections with American interests; in short, it may be said that the electrical industries of France appear to have followed closely the lines of German development in the same industries, the bulk of the undertakings being ranged in a few groups. For many interests these groups, far from being antagonistic, co-operate as regards production (*e.g.*, lamps) or as regards markets (*e.g.*, railway electrification). A long appendix to the report deals in detail with the operations and ramifications of the leading French electrical companies. This is not of a nature which permits abstraction, but it may be said that it shows the close connection between a great number of concerns.

Hydro-Electric Development.

The lack of capital, coupled with the instability of prices, has caused a deferment of many important water power schemes, and thus, whilst the erection of certain high power stations, *e.g.*, Eguzon on the Creuse, Brommat on the Truyère, and Pougny-Chancy on the Rhône, has been proceeded with for various urgent reasons, the larger schemes, *i.e.*, those of the Rhine and the Rhône, which, together, at a cost of six milliard fr., would provide an additional 1,700,000 h.p., have not been started. Accordingly only some 25 per cent. of the total resources has been made use of. The figures given in the report show that the total power in service is 775,210 kW; 339,690 kW was under construction, and 4,003,900 kW was projected. The greatest development has taken place in the south-eastern district of France, in which almost 60 per cent. of the total power is utilised. In Savoy and Provence more than 160 stations are actually in operation, while about a dozen are in course of construction. The Isère is the principal waterway in the district, and 87 stations have been built upon it; 230,000 h.p. has been developed in the south-west, and stations providing a further 100,000 h.p. are under construction. In the central region 79 stations provide more than 100,000 h.p., the Dordogne stations contributing more than one-third of the total. The Paris-Orleans Railway Co. is building three important stations in this region. Little progress was made during 1924 in the north-east and Alsace-Lorraine. Schemes are in hand, but in the meantime deferred, for utilising 800,000 h.p., whereas the total power in service scarcely exceeds 15,000 h.p. at present. Development has also proceeded very slowly in the north and north-west districts, but schemes are in hand for the harnessing of about 100,000 h.p. As regards the tidal power station at Aber-Wrach no progress has been reported during the past year. Full official sanction has been received to the scheme, and there is no doubt that the erection of the station will be undertaken in the near future.

The report also makes mention of the Rhine development, which, in addition to improving navigation, aims at developing about 700,000 h.p. Agreements have been drawn up and certain concessions have been granted. No progress has been made with the definite constitution of the company which was to take in hand the great Rhône scheme. The delay is said to be due to the increased cost of construction, a doubt whether the power will be cheaper than that produced by "thermic" stations, and the difficulty of providing the necessary financial resources.

* Stationery Office, 8s. net.

Railway Electrification.

The present French railway electrification programme of three systems covers about one-third of the French railway mileage, or between 2,000 and 2,500 miles each for the Paris Orleans, the Midi or Southern, and the Paris-Lyons-Mediterranean Railways. The first and second have continued their active work in this respect. The development in 1924 by the Midi Railway included the completion of the stretch of 190 miles from Toulouse to Dax, and, later, the line from Irun through Hendaye and Bayonne to Bordeaux (148 miles) was completed. A number of branches have also been electrified. The work already executed and to be carried out in 1926 will bring the total electrified mileage up to 685, and further progress will be made after this year. Three of the five hydro-electric stations in the Pyrenees are working, the other two being in course of construction. For the eastern section of the Southern Railway two at least of the group of six or seven stations have been completed. The Government has fixed the system for future electrification at 1,500 V d.c. The Paris-Orleans Railway has continued the first part of its programme, *viz.*, the electrification of a stretch of 312 miles from Paris to Brieve, but it appears to be behind the scheduled time. Eguzon station is in service, while the construction of three power stations on the Dordogne river is progressing. The stock delivered during 1925 included five high-power locomotives of the gearless type, developing 2,300 h.p. each; under test one of these attained a speed of 70 m.p.h. So far the Paris-Lyons-Mediterranean Railway is only operating a single section electrically, although its programme provides for the conversion of 2,044 miles. Work is proceeding on the 84-mile line from Culoz to Modane. Of the other main systems the State Railway appears to be the only one engaged in the electrification of any sections, and it is confining itself to the Paris region.

Telegraphs, Telephones and Radio.

The dispatch, by the Belin system, of written messages, introduced by the French Post Office in 1923, has continued. This method of telegraphy may now be employed between Paris and several French towns. The number of telephone subscribers has doubled since 1914, and is now about 600,000. Radio has made very rapid progress in France, which now possesses 40 stations in operation, with as many more in course of building, or planned. The Post Office has erected transmitting stations for telephony at several chief towns, and those at Paris, Strasburg, Lyons, Versailles, Bordeaux, Angers, and Toulon are already working or will be working shortly. The units of this network have an effective radius of 1,000 km. The organisation of the manufacturing industry for radio is very strong; the entire industry is concentrated in fact in the Compagnie Générale de Télégraphie Sans Fil, with a capital of 62.5 million fr., which controls or participates in practically all other French concerns and has large interests in Belgian, Italian, Polish, Jugo-Slavian, Swiss, and Czecho-Slovakian concerns, as well as in Brazil, Argentina, Chile, and the Far East.

The Electro-Chemical Industry.

In an appendix to the report a great amount of information upon this subject is given. The class of products turned out and the provision of the necessary power are dealt with in great detail. Particular mention is made of the Compagnie Produits Chimiques et Electro-Métallurgiques Alais, Froges et Camargue (Péchiney), the predominant concern in the electro-chemical and electro-metallurgical industries. Several large power stations have been erected by this company, but they are proving insufficient for the demands, and further new plants are being constructed. Another company which has erected important water power stations for electrochemical purposes is the Société d'Electro-Chimie, d'Electro-Métallurgie et des Aciéries Electriques d'Ugine, which has seven stations of a total capacity of 32,000 kW.

General.

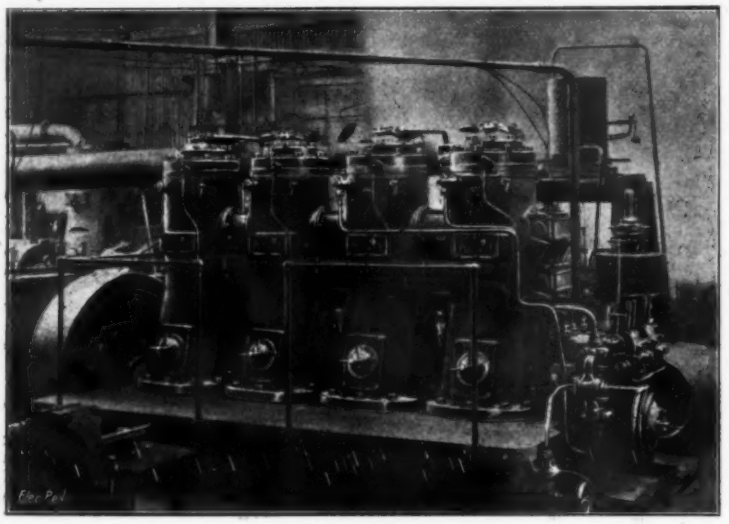
During 1925, as reported in our pages at the time, a lacuna in French company law was filled by the institution of limited liability companies, analogous in many respects to similar bodies in the United Kingdom. Two Bills were introduced by the Government in July, 1924, to amend the legislation with regard to patents and trade marks. The object of the first Bill was to bring the French patent law into agreement with the International Industrial Property Convention; it extends the period during which patents are valid from 15 to 20 years, and revises the scale of fees. The Bill with regard to trade marks also extends the period of validity from 15 to 20 years. It also recognises and protects collective marks, the legality of which had hitherto only been recognised incidentally. Foreigners may obtain the benefits of these Bills by complying with the same formalities as French citizens.

The French State is taking a very active part in the promotion of foreign trade, and since the war it has created a Department of Overseas Trade (modelled in most respects upon the corresponding British Department), which directs the work of 54 commercial attachés in foreign countries and maintains exhibition offices in many cities. The department also works in close collaboration with the important national committee of foreign trade advisers, which is appointed from among the representatives of the export trades in France, and French merchants of standing in foreign countries.

An Improved Crude-Oil Engine.

Some Particulars and Test Results of the "Plenty" Heavy-Oil Engine.

We have received some interesting information concerning the recently re-designed "Plenty" heavy-oil engine, a product of the firm of Messrs. Plenty & Son, Ltd. This engine is of the vertical two-cycle type, employing a crankcase scavenge, and it is made in sizes ranging from 30 to 300 b.h.p. Although the engine is made in one-, two-, three-, four- and six-cylinder units, two sizes of cylinders only are employed, *viz.*—270 mm. bore, 300 mm. stroke; and 335 mm. bore, 390 mm. stroke. The new models, while still retaining the usual features of the previous ones, embody many improvements. The totally water-cooled head is retained and a hot spot in the form of a small plug is utilised for starting; either this may be heated by means of a blow lamp, or an electric starting device may be employed. The starting is effected by means of a pilot jet which impinges upon the hot spot. This is closed off as soon as the engine starts, and the main injector in the top of the head automatically comes into operation. The governing of the engine is effected by altering the length of the fuel pump stroke. The governor and the fuel pump gear are located at the end of the engine, a camshaft being placed across the engine and driven through spiral gears. The cams operate vertical rocking arms which are mounted on a hand operated eccentric fulcrum shaft, which serves to throw the rocking arms out of action for starting and stopping.



A 4-Cylinder "Plenty" Crude-Oil Engine.

Interposed between the upper end of the rocking arm and the fuel pump plunger is an adjustable tappet. This is made in two halves, one half being free to move endways but not to rotate. This part of the tappet is threaded internally, and into it is screwed the second half. On its exposed periphery teeth are cut which engage with a sliding rack. The latter, which engages with all the tappets on a multi-cylinder unit, is coupled to a centrifugal governor. The governor itself is driven from an extension of the camshaft and is designed to deal with large and sudden variations of load without any external adjustment. The accompanying illustration shows a four-cylinder "Plenty" engine.

Some particulars of tests made on a 200-h.p. "Plenty" engine which was recently supplied to Messrs. Edmundsons, Ltd., for their Newbury power station, add to the interest of the above brief description. The engine was run at full load, 600-lb. brake load, at an average speed of 302 r.p.m. The b.h.p. measured was 201.5 and the fuel consumption for the period under these conditions was 94.5 lb., representing a consumption of 0.468 lb. per b.h.p.-hour. Under three-quarter load the b.h.p. was 152.5, and the fuel used per b.h.p. was 0.515 lb. The consumption at half load was 0.55 lb. per b.h.p. at a measured output of 102 b.h.p.

Developments in Electrically-Driven Centrifugal Machines.

The "Weston" Centrifugal Machine.

THE progress which is being made in this country in the beet-sugar industry emphasises the need for a reliable direct-driven electric centrifugal machine. The firm of Watson, Laidlaw and Co., Ltd., has made a considerable advance in this direction in the design of a machine in which, it is claimed, the electric motor and the centrifugal are each constructed efficiently on its own merits without necessitating the construction of the two elements in one frame. The electric motor is fixed on the frame-work above the centrifugal which it drives at the upper end of the centrifugal spindle through the medium of a combined flexible coupling and friction pulley, ensuring that the oscillation of the lower machine is not transmitted to the motor itself, thus permitting the rotor and stator air gaps to be kept to a minimum. The coupling and friction pulley combination is so constructed that, by a simple adjustment, the rate of the acceleration of the centrifugal may be varied to suit the particular class of sugar under treatment. The friction pulley enables the motor to run up to speed before the load is applied, thus permitting the use of a motor designed for starting by connection to the supply mains direct. The centrifugal spindle runs in ball bearings and carries a special conoidal rubber buffer. The combination of the ball bearings and this buffer is said to render the machine durable and easy running, with a minimum of oscillation, and with a much greater unbalanced load than has hitherto been possible. The buffer is self adjusting and hence avoids the tightening of screws as it wears.

Another feature of the machine is a hollow hinged post with which the motor is fitted, enabling it to be raised and turned round, clear of the top of the spindle, without disturbing any of the electrical connections, thereby giving access to the bearings and buffer of the centrifugal spindle. Fig. 1 shows the motor disconnected from the other machine. The former is fitted with a special interlocking switch and brake gear, by means of which the operations of starting, stopping and applying the brake are made by one lever only; the act of applying the brake opens the motor switch so that it is not possible to start the motor when the brake is on or to apply the brake until the supply has been cut off. The motor is totally enclosed and hence protected from the moisture usually prevailing in a sugar-house. Either d.c. or a.c. motors of suitable design can be used with the Weston machine. The position of the motor on the frame at the top of the centrifugal renders unnecessary the provision of special foundations for it. Fig. 2 illustrates a vertical section of an electrically-driven centrifugal machine, and fig. 3 shows a complete unit.

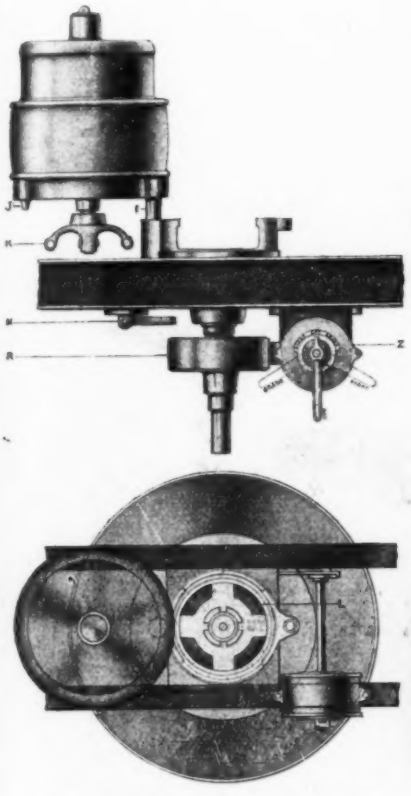


Fig. 1.—Machine with Motor Disconnected.

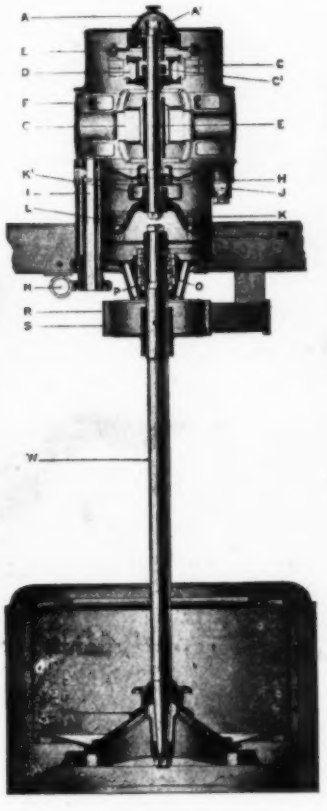


Fig. 2.—Vertical Section.

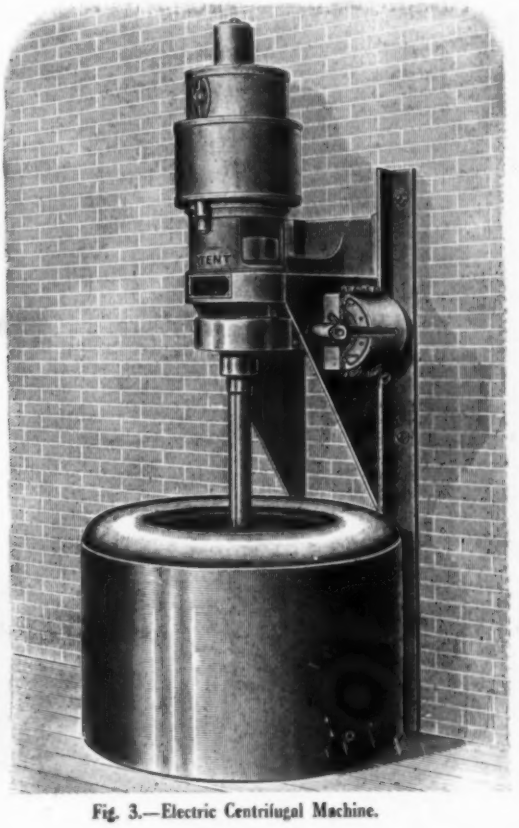


Fig. 3.—Electric Centrifugal Machine.

INDEX TO PARTS.

A, Cover of bearing; A', Top of ball-bearing; B, Brush-holder; C, Brushes; C', Commutator boss nut; D, Commutator; E, Motor spindle; F, Field coils; G, Armature; H, Lower ball-bearing; I, Patent hollow post; J, Motor attachment pin; K, Driver; K', Grease cup; L, Friction shoes; M, Coupling on centrifugal spindle; N, Worm and worm wheel; O, Ball bearing; P, Patent buffer; R, Brake; S, Brake pulley; T, Basket; U, Monitor case; V, Discharge valve; W, Centrifugal spindle; Z, Switch interlocked with brake.

New Electrical Devices, Fittings, and Plant.

(Readers are invited to submit particulars of new or improved devices and apparatus.)

A Speed-Indicating Relay.

According to *Power* a speed-indicating automatic relay, designed primarily for use with small, low-speed, vertical water-wheel generators operating under full automatic or remote supervisory control systems, has recently been placed on the market by the WESTINGHOUSE ELECTRIC & MANUFACTURING CO., U.S.A. It is mounted directly on the end of the rotor shaft, and is enclosed in a sheet-metal housing, having a removable top for inspection. Control energy is supplied through five slip rings, encircling the relay mechanism and insulated from it by a micarta tube. Through these five rings and their corresponding brushes any desired system of remote or automatic control can be connected. The relay operates on the centrifugal principle and assists other relays and contactors in controlling the station. It has three contact points—starting speed, synchronous speed and above-normal cutout-speed. When the generator is started, either automatically or by a distant operator, its increasing speed causes a vertically suspended governor weight, held against spring tension in the relay, to move outward, and as the speed approaches synchronism, contacts are closed, completing a circuit, which operates to throw the generator directly on the line. If, for any reason, conditions of other automatic apparatus are adverse to the generator's being connected to the line, and the breaker is thereby prevented from closing, the generator speed must decrease until the relay contact is established with the initial starting point before it can be started up. This assures safety to both the generator and its main control apparatus by ensuring that all starting operations are performed in proper sequence.

After the generator has been successfully connected to the load, should its speed increase to approximately 40 per cent. above normal, the third contact in the relay would automatic-

ally disconnect the machine, open the field switch and close the gates. The generator's speed must fall to the value of the first contact position before it can be re-energised.

An Improved Duplicator.

We recently witnessed a demonstration of duplicating work on the "Opalograph," an apparatus presenting a new departure in this work, which should prove a useful equipment in the drawing office. The main feature of it is a special opal glass plate to which the original is transferred and from which perfect copies can afterwards be taken, in any colour, of typewriting, handwriting, drawing, &c. The original is prepared in a special ink. A preserving fluid is first applied to the plate, after which the original is pressed to it, face to face, a frame press being provided for this purpose. The plate print is then fixed with a special fixing ink. Copies can then be taken from the print by the usual method. It is claimed that up to 300 copies can be taken from one fixing and that the original can be re-used, fresh preserving fluid and inks being applied. The apparatus is made in sizes to accommodate an original up to a yard square and is marketed by MESSRS. OPALO, LTD., 259, High Holborn, London, W.C.1.

Actino-Therapy Lamps.

The accompanying illustration, fig. 1, is of the "Westminster Junior," one of a range of actino-therapy lamps manufactured by the WESTMINSTER ENGINEERING CO., LTD., Victoria Road, Willesden Junction, N.W.10. It is claimed that the lamp gives a light of great intensity, rich in ultra-violet, luminous

Fig. 1.—Actino-Therapy Lamp.

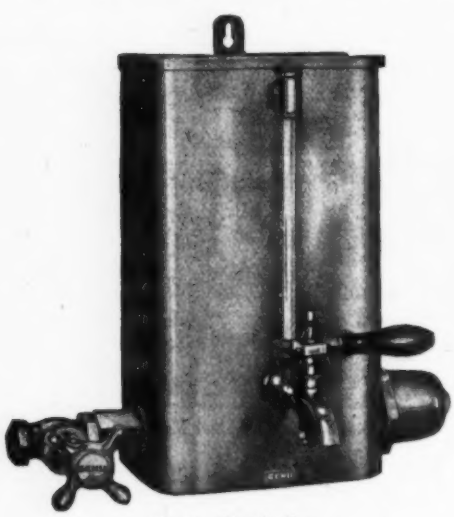


Fig. 2.—Electric Urn.

and heat rays. The proportion of ultra-violet rays can be varied by the use of various electrodes, such as tungsten, &c. It is also claimed that the lamp will burn for three hours without receiving attention. It is supplied with the necessary variable resistances or choking coils for use on d.c. or a.c. circuits as the case may be. Many of the leading hospitals are using "Westminster" lamps and, it is said, excellent results have been obtained in cases of rheumatism, neuritis, sciatica, lumbago, &c.

A New Design of Electric Urns.

The electric urn shown in fig. 2 is one of a new range of such apparatus recently marketed by Messrs. GEORGE NOBBS, LTD., 87-89, Cleveland Street, Fitzroy Square, London, W.1. The "Genii" urns are made in circular or rectangular patterns. The latter are designed for fixing to a wall or bulkhead. They are provided with a threaded boss for a cold-water feed, if required, or they may be filled from the tap by raising the top cover. The heating element consists of a "Genii" immersion heater equipped with a gun-metal terminal box. The urn illustrated has a capacity of 1½ gallons, but similar designs are made with capacities up to 10 gallons.

An Improved Boiler Meter.

The accompanying illustration, fig. 3, shows the construction of the "Bailey" boiler meter, the latest production of INDUSTRIAL COMBUSTION ENGINEERS, LTD., Astor House, Aldwych, London, W.C.2. It is designed to record the steam-flow, air-flow, and the flue-gas temperature, and also to indicate the furnace draught. The steam-flow is indicated by a red line on a disk chart, which can read either in lb. of steam or as a percentage of the boiler rating. The measure of the flow of air through the furnace is recorded by a blue line which, for the best operation, should coincide with the red steam line; a space between the lines indicates the necessity for attention to the working conditions. The temperature of the flue gases is recorded by a green line which indicates whether or not the heating surface is absorbing the maximum amount of heat. The steam-flow recorder is operated by the differential pressure across an orifice in a Monel metal disk inserted between a pair of flanges in the steam pipe between the boiler and the header. The air flow element employs the same basic principles. The draught pressure drop across the boiler is applied to two bells sealed in oil and suspended from knife edges on a beam. The latter is supported on knife edges and carries a displacing member immersed in mercury. Any increase in the rate of flow of the gases is accompanied by a greater pressure difference which, acting on the bells, produces a motion of the beam, thereby drawing the displacing member out of the mercury reservoir. The member moves until balance is obtained. The temperature measurer is a nitrogen-filled bulb which gives a true average temperature in virtue of its sensitive-bulb section being long enough to extend entirely across the width of the boiler. The measurement of furnace draught, which is indicated on the side scale, is based upon the differential

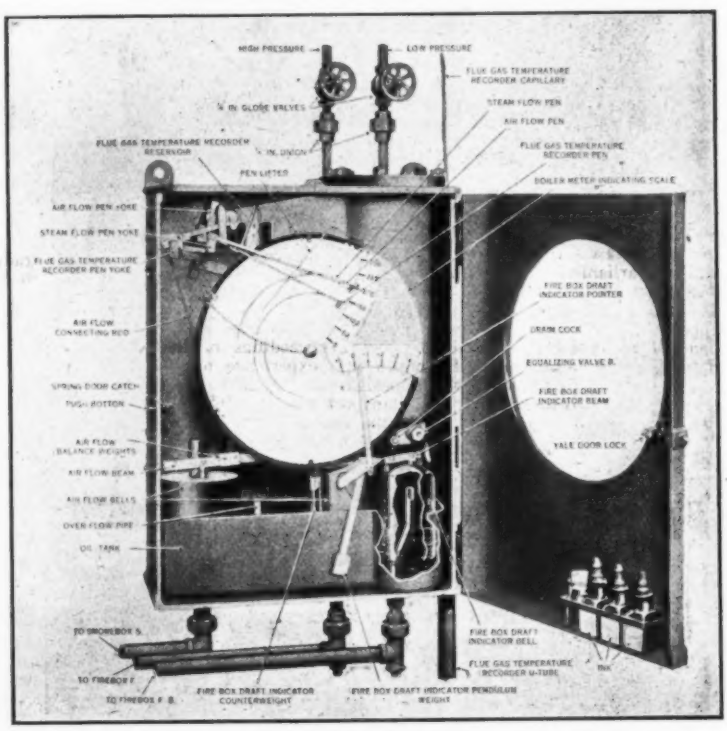


Fig. 3.—Modern Boiler Meter.

draught pressure between the furnace and the uptake to the chimney and is therefore taken across the gas passages of the boiler where the greatest dependable pressure-drop occurs.

A New Electric Safety Lamp.

We are informed that a new electric safety lamp, for use in collieries in which dust and fire damp have to be contended with, has recently been approved by the French Government. It is made by the Société d'Eclairage et d'Applications Electriques, of Paris, and is known as the "L.D.H." It utilises a 2.4-V alkaline battery with plates of iron, cadmium, and nickel, with an electrolyte having a free potassium base. The lamp, which gives a light of 1¼ c.p., for 10 hours, is about 10 in. high by 3¾ in. in diameter, and weighs 5¼ lb.

Electric Supply Timepiece.

An interesting development in electric clocks, the "Telechron," has been introduced by the WARREN CLOCK COMPANY of America. For the successful operation of this device an a.c. supply of constant frequency is essential. The propelling force is in the form of a small synchronous motor, to which is suitably geared the clock movement, so that if the frequency of supply does not vary the correct time can be maintained. It is intended that the apparatus should serve as a master clock for any electric-clock installation. The clock is made in many models of cast bronze finished in verde antique.

Parliamentary News.

(By Our Special Parliamentary Reporter.)

Horley Electricity Order.—On December 18th, in the House of Lords, it was reported that the Special Orders Committee had heard evidence from the parties concerned and did not recommend that a further Parliamentary inquiry should take place; but should the Horley and District Electricity Special Order, 1925, be approved, the Committee recommended that it should be approved subject to the omission of Clause 8 and Schedule 5. Lord Donoughmore, the Chairman of Committees, moved that the Report be considered and adopted. He said that both parties were in agreement that no further inquiry was necessary. Certain salient points came up during the hearing before the Special Orders Committee. The first was that the scheme under the Order was still incomplete. A further Order, if not further Orders, would be necessary, and it was understood that they were in progress. It also became quite clear that the promoters of the Order desired to carry out their obligations through the medium of a bulk supply scheme and not through a small separate generating station, and they agreed to the deletion of Clause 8, which authorised them to set up a generating station, and to the deletion also of the schedule relating to it.

The report of the Committee was then adopted.

On December 21st Lord CLARENDON withdrew his opposition to the approval of the Order, stating that the Gas Company did not wish to proceed further with the matter. Lord PLYMOUTH then moved that the Order be approved, subject to the omission of Clause 8 and Schedule 5.

Lord ULLSWATER said that the House of Lords was asked to reverse its decision on the Bill on the *ipse dixit* of the Ministry of Transport, which had never heard the competing parties. The best solution of the whole difficulty would be that neither scheme should go through this session, and that at the beginning of next session both parties should start afresh and get a proper hearing before the tribunal of Parliament. Lord CARSON spoke to the same effect.

Lord DONOUGHMORE said that he felt that the House had no alternative but to accept the proposal of the Ministry of Transport, which, by the Act of 1919, that House had made the responsible agent of Parliament in these matters. In this case the Minister invited the Gas Company to appear at an inquiry, but the company refused because its Bill was then before Parliament, and it preferred to rely on that. He was given to understand that the appeal from the Electricity Commissioners to the Ministry of Transport was a real appeal. It was argued that the Ministry was absolutely independent and judicial, and reviewed the proceedings of the Electricity Commissioners. He hoped that experience might show in future cases that the appeal from the Electricity Commissioners to the Ministry of Transport was a real appeal and not merely a re-submission of the case from one room in an office to another room in the same office. The Gas Company all through these proceedings had been in the position that it could not itself go to the Electricity Commissioners and ask for the Electricity Order—though the Electricity Company could do so—and accordingly it had no remedy but to promote a Bill in Parliament. One difficulty had disappeared; the Act of 1925 for the first time made it unnecessary for a gas company to come to Parliament direct. It could go to the Electricity Commissioners for an Order in the same way as any other authority. He hoped, therefore, that the difficulty would not recur in future cases.

After further debate the Special Order was approved, subject to the deletion of Clause 8 and Schedule 5.

Special Orders relating to Blackburn, Helensburgh, Leyland, North Berwick, Pontypool, West Wilts, and Aylesbury were also approved.

Australian Wireless.—On December 21st, the Prime Minister informed Lord Apsley that the Australian Wireless Company had applied for a licence to operate a radio station in Great Britain for communication with Australia, but it had been informed that, in conformity with the policy adopted by the late Government and confirmed by the present Government, the operation of all the Imperial services in this country would be concentrated in the hands of the Post Office. A contract for the erection of radio stations for communication with Canada, South Africa, India and Australia was made by the Post Office on July 28th, 1924, and approved by resolution of the House of Commons. Those stations were approaching completion, and when they and the corresponding Dominion stations were available, direct radio services would be commenced.

Iron and Steel Trades Safeguarding.—On December 21st, Mr. BALDWIN, replying to questions, said that the application of the iron and steel trades to the Board of Trade for the appointment of a committee under the Safeguarding of Industries procedure was referred to the Committee of Civil Research, and its report had been received by the Cabinet. The Committee had given the subject prolonged and detailed consideration and had heard a large number of witnesses, representing employers and employed, engaged in the iron and steel industries and in allied trades. The evidence revealed a serious situation. The pressure of foreign competition, aided by long hours, low wages, and depreciated currencies, was being severely felt by our manufacturers, and had the Government been able to deal with the iron and steel industries in isolation it might have regarded the case for inquiry as complete. It was clear, however, that the safeguarding of a basic industry of that magnitude would have repercussions of a far wider character which might be held to be in conflict with the Government's declaration in regard to a general tariff. In all the circumstances of the present time the Government had come to the conclusion that the application could not be granted. The Government would keep those industries under close observation with a view to promoting their well-being should any other measures be deemed desirable. It was hoped that the loan for railway development in East Africa which was recently approved would be found helpful, and further similar projects were under consideration.

Wireless Operators in Ships.—On December 21st, Sir B. CHADWICK informed Mr. W. Baker that since November 26th about 24 ships conveying mails to destinations overseas had proceeded to sea without wireless operators, and about 14 others were without a full complement of operators.

Russian Electrical Notes.

Inferior Quality of Manufactures.—The question of the quality of various industrial products is engaging the attention of interested circles in Moscow from the users' point of view. In this connection a representative of the railways states that in 1924-25 23.5 per cent. of the deliveries had to be rejected, including special telephones, insulators, &c. At a conference held in Moscow at the beginning of December complaints were also made concerning the supply by the trusts of defective lamps, many of which had a very short life; unreliable motors, &c.

A High-power Lamp.—A report from Leningrad states that Prof. Hekkel, in co-operation with Prof. Bulgakoff and Prof. Mitkevich, claims to have constructed in an experimental laboratory a new electric lamp having a million candle power without a reflector.

A Large Radio Station.—The Low-Pressure Trust has prepared a scheme for the establishment in Moscow of a 1,000-kW radio station which is intended for direct communication with Europe, Asia and America.

Manufacturing Profits.—The accounts for the year ended September 30th, 1925, of the Central Electrical Trust, which has now been amalgamated with the Leningrad Electrical Machine Trust, have been published. According to the profit and loss account, as published in abstract in the Moscow official newspapers, the year closed with net profits amounting to 2,246,000 roubles. After placing 449,000 roubles to reserve, allocating 337,000 roubles to welfare purposes, paying the directors' fees, totalling 22,000 roubles, and income tax, a net surplus of 1,033,000 roubles remained.

Rural Electrification.—During the current fiscal year (1925-26) the Electric Rural Construction Undertaking intends to proceed with the construction of 44 rural generating stations and the electrification of over 11,000 peasant villages at a total expenditure of 2,300,000 roubles. In accordance with the development of its activity the undertaking proposes to extend the period of credit up to five years and in special cases to seven years, and the credit on the average will amount to from 75 to 80 per cent. of the cost of the installations. The general outlay on the electrification of the villages ranges from 60,000 to 132,000 roubles each.

Development of Production.—The Industrial Section of the State Planning Commission has had under consideration a report by the General Electric Commission concerning the specialisation and development of the electrical manufacturing industry in the year 1925-26, and in connection with the extension programme for the ensuing five years. As a result of the applications already made for deliveries in 1925-26 the report states that the demand of the country can be determined at 170,000,000 pre-war roubles (£17,000,000); the works under the control of the commission are expected to turn out manufactures of the value of 104,000,000 roubles. The Kolchugino cable factory is to produce goods to the extent of 21,000,000 roubles and the remaining, smaller, works products valued at about 5,000,000 roubles. These figures make a total of 130,000,000 roubles, representing the production of the Soviet undertakings. It will, however, be necessary to expend a sum of 15 millions of roubles on repairs and re-equipment and about 6 millions on new manufacturing undertakings in order to bring the total output capacity up to the 104,000,000 roubles in this year in the case of the works under the auspices of the commission, and to a capacity of 140,000,000 roubles in 1928-29.

Tramway Prospects.—A statement has been issued in Moscow concerning the future requirements of the tramways. It is calculated that about 1,500 cars will be needed this year (1925-26). According to information furnished by the General Metal Commission, the cost of constructing cars at Soviet works is much higher than the cost of German cars. The output capacity of the Russian works is put at 1,100 cars per annum. The State Planning Commission, before which the statement was placed, has fixed the number of motor cars to be ordered this year at 1,000, with 600 reserve motors. As

supplementary equipment will have to be obtained from abroad, the commission has expressed the desirability of limiting the needs in this respect to from 5,000,000 to 6,000,000 roubles. In connection with this question it is stated that the Moscow tramways earned gross receipts of 33,200,000 roubles in 1924-25, the expenditure having been 23,200,000 roubles. Out of the profits of 10,000,000 roubles the sum of 5,000,000 roubles has been assigned to the acquisition of new cars, &c.

A Breakdown at the Kaschir Station.—It is reported that in November a breakdown occurred in a 7,500-kW turbo-generator at the Kaschir station owing to an unknown cause. A reserve machine was at once brought into use. The repairs were expected to occupy three weeks. No interruption is stated to have taken place in the supply system of Moscow as a consequence of the defect.

The Five Years' Electrification Scheme.—Some particulars have been published concerning the position of the scheme of electrification of Russia which was originally prepared five years ago. It is stated that out of the 30 regional stations contemplated 14 have been built or are in course of construction; projects have been prepared in regard to three other stations, while 13 have not been commenced. The total capacity of the works built, in course of establishment, and projected, amounts to 712,500 kW, and the stations not yet begun represent a further 1,037,500 kW. The non-completion of the original programme is claimed to have been compensated for by the construction of two new regional stations which were not included in the former plan, namely, the Semo-Avchalsky and the Lyaninsky stations, and by some other stations of local importance. As to the conversion of main railways to electric traction, as was projected in the original scheme, it is admitted that this has not yet been commenced, as sufficient allowance had not been made for the radical reconstruction which was necessary before electrification could be proceeded with. At present the only work of electrification of railways is being undertaken in connection with the lines in Baku and the suburbs of Moscow. The total capacity of the stations of public importance and of those at industrial works which are considered as "regional" stations amounts to 480,400 kW.

Legal.

Theft of Electricity.

ON December 23rd, at Cardiff, Alfred Warren was prosecuted for fraudulently abstracting electricity from the Corporation's mains. It was stated in evidence that the defendant had removed the seals from the cut-outs in premises in Stuart Street, and the meter leads had been tampered with so that current did not pass through the meter. The defendant stated that he was engaged to install some lights in the house, and he found that the fuse box was not sealed. He did nothing to alter the fuse boxes. He admitted that he had not informed the Electricity Department that the installation was ready for inspection.

A fine of £3, or in default one month's imprisonment, was imposed.

Ridley v. J. Gledson & Co.

WE are informed that on December 17th, at Middlesbrough County Court, Messrs. J. Gledson & Co., electrical wholesalers, Newcastle, appeared in answer to a summons issued by Mr. C. E. Ridley, of Middlesbrough, to obtain payment of 5s. 6d., being the amount claimed for a sample. Messrs. Gledson & Co. stated that they had not ordered the goods, which were lying at sender's risk in their stores. The Judge, in dismissing the case with costs against plaintiff, stated that the sender's contention that the goods should have been returned could not be upheld.

Trade-mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from December 23rd. In the case of foreign applications, the names and addresses of the British representatives are also given :—

Krone. No. 455,400. Class 4; and Electrax. No. 555,451. Class 8. Electric carbons.—The firm of C. Conradty, 9, Spittlertorgraben, Nuremburg. (S. Sokal, 1, Great James Street, Bedford Row, W.C.1.)

Desulphate. No. 463,727. Class 8. Accumulators and batteries.—T. W. Underwood, 45, Furneaux Avenue, Knights Hill, West Norwood, S.E.27.

Agolindus. No. 461,257. Class 8. Philosophical and scientific instruments and apparatus for useful purposes.—Gesellschaft für Electricitats Industrie, 8, Motzstrasse, Berlin, W.30. (Cruikshank & Fairweather, 65-66, Chancery Lane, W.C.2.)

The Akk-e-Mmar, A.M.R. (lettering and design). No. 462,289. Class 8. Rectifiers for alternating current.—Autes-Mechanical Rectifiers, Ltd., 91, Tabernacle Street, E.C.2.

Faithful Service (lettering and design). No. 463,252. Class 8. Instruments and apparatus and parts thereof for use in radio-telephony and telegraphy, electric batteries, &c.—H. P. Taylor, trading as Paul Taylor, 147, Stamford Road, Kettering.

The Advance (lettering and design). No. 463,729. Class 8. Instruments, apparatus and parts thereof for use in radio-telephony.—Equipments, Ltd., 26-27, Avenue Chambers, Southampton Row, W.C.1.

Transadyne. No. 464,401. All goods in class 8.—Neutron, Ltd., 3, Warwick Court, Gray's Inn, W.C.1.

Arga. No. 463,335. Class 13. Electric incandescent lamps.—Naamlooze Vennootschap Philips Gloeilampenfabrieken, Eindhoven, Holland. (Boult, Wade & Tennant, 112, Hatton Garden, E.C.1.)

Pigellite. No. 464,325. Class 40. Copper wire covered with india-rubber or gutta-percha.—Pirelli-General Cable Works, Ltd.

Published Specifications.

Compiled expressly for this journal by Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1924.

15,713. "Electrical structures." W. Dubilier. June 30th, 1923. (218,328.)
15,851. "Radio receiving systems." A. E. White (Electric Apparatus Co.). July 1st, 1924. (243,773.)
18,485. "Electrical condensers." F. K. Woodroffe and R. H. N. Dawson. August 2nd, 1924. (243,776.)
18,722. "Telephonic receivers." E. A. Graham. August 6th, 1924. (Cognate application 23,506/24.) (Addition to 221,856.) (243,781.)
20,292. "Wireless transmission and reception of photographs." N. Diamant. August 27th, 1924. (243,783.)
20,337. "Heating elements for electric heaters, radiators, cookers, and the like." F. B. Cox. August 28th, 1924. (243,784.)
20,368. "Mounting of incandescent filaments." Mullard Radio Valve Co., Ltd., and L. S. Harley. August 29th, 1924. (243,785.)
20,582. "Electromagnetic devices." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.). (Western Electric Co. Inc.). September 1st, 1924. (243,787.)
20,676. "Secret service systems for rural and party-line telephones." H. B. Sherman. September 2nd, 1924. (243,791.)
20,685. "Folding or collapsible frame aerial." P. Rinkel. January 15th, 1924. (227,789.)
20,770. "Mechanical vibration filters." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.). September 13th, 1923. (221,792.)
20,780. "Electrical condensers." G. W. Hale and Radio Engineering Co., Ltd. September 3rd, 1924. (Cognate application 29,602/24.) (243,794.)
20,879. "Automatic cut out means for electric irons and the like." H. B. Irvine and H. Wooff. September 4th, 1924. (243,799.)
20,886. "Thermionic rectifier systems." E. Y. Robinson, C. R. Burch, and Metropolitan-Vickers Electrical Co., Ltd. September 4th, 1924. (243,800.)
20,930. "Supporting of electric insulators." R. L. Cleaver (C. S. Harrison). September 4th, 1924. (243,806.)
20,932. "Means for connecting the insulating and metal parts of insulators." W. H. Goodman and Dubilier Condenser Co., Ltd. (formerly Dubilier Condenser Co. (1921), Ltd.). September 4th, 1924. (243,807.)
21,038. "Electric signalling systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co. Inc.). September 6th, 1924. (243,815.)
21,177. "Sound-box diaphragms for use in telephones, loud speakers, acoustic apparatus, and the like." C. Lindstrom Akt. Ges. and F. Jokel. September 8th, 1924. (243,818.)
21,221. "Electric heaters for fluids." W. Stubbs and H. Stubbs. September 19th, 1923. (222,113.)
21,474. "Portable electric lamps." A. Trafford. September 11th, 1924. (243,828.)
21,533. "Solenoid-operated mechanism." British Thomson-Houston Co., Ltd., H. Trencham, H. C. Heath, W. P. Hamlyn, and H. E. Cox. September 11th, 1924. (243,829.)
21,749. "Joints of electric cables." C. J. Beaver and W. T. Glover & Co., Ltd. September 15th, 1924. (243,834.)
22,069. "Electric cable-connecting devices." A. W. G. Tucker and Ferranti, Ltd. September 18th, 1924. (243,839.)
22,883. "Switch mechanism and cable connections for electric motors." Mavor & Coulson, Ltd., and W. Lawrence. September 29th, 1924. (243,843.)
23,947. "Fixed condensers, more particularly for use in connection with wireless telegraphy and telephony." Igranic Electric Co., Ltd., and E. A. Bitton. October 9th, 1924. (243,852.)
23,971. "Electric heaters and process of manufacturing of same." Dr. M. Hauser. October 9th, 1924. (243,854.)
24,859. "Devices for use in connection with sparking plugs for internal-combustion engines." O. Gadiel and M. Apel. October 20th, 1924. (243,865.)
25,063. "Electric switch or commutator." C. E. Foster. October 21st, 1924. (243,866.)
25,142. "Electron discharge devices." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.). (Western Electric Co. Inc.). October 22nd, 1924. (243,868.)
25,568. "Electric condensers." Dubilier Condenser Co., Ltd. (formerly Dubilier Condenser Co. (1921), Ltd.). (A. Nyman). October 27th, 1924. (243,873.)
26,951. "Absorption brake dynamometers." Heenan & Froude, Ltd., and G. H. Walker. November 12th, 1924. (243,888.)
28,080. "Asynchronous electric motors." Forges et Ateliers de Constructions Electriques de Jeumont. December 27th, 1923. (226,791.)
28,156. "Electrically-heated pressing or smoothing apparatus." L. W. Skogh (*née* Wahlgren). November 24th, 1924. (243,894.)
28,163. "Ignition." C. Baxter. November 25th, 1924. (243,895.)
28,582. "Electric fires." P. M. Edinborough and Metropolitan-Vickers Electrical Co., Ltd. April 23rd, 1924. (Cognate application 10,572/25.) (243,896.)
29,264. "Means for securing and locking electric lamps in position." J. Illingworth. December 6th, 1924. (243,900.)
29,807. "Connectors for electrically-bonding the rail joints in electric railways." J. G. Kjellgren. December 11th, 1924. (243,702.)
30,060. "Alternating-direct current converter with wide voltage regulation." J. L. La Cour. December 15th, 1923. (226,233.)

1925.

543. "Telephone systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.). January 19th, 1924. (227,824.)
953. "Electrical couplings." W. O. Kennington. January 12th, 1925. (243,918.)
1,092. "Filament for electric apparatus." Naamlooze Vennootschap Philips Gloeilampenfabrieken. May 21st, 1924. (234,442.)
5,093. "Coil-holders for wireless purposes." S. C. Price and Pressland Electric Supplies, Ltd. February 24th, 1925. (243,985.)
5,917. "Processes and apparatus for forming squirrel-cage windings for induction motors." M. C. Spencer. March 4th, 1925. (243,950.)
6,900. "Cores of compressed magnetic powder for induction coils and the like, and method of manufacturing the same." British Thomson-Houston Co., Ltd. (International General Electric Co. Inc.). March 13th, 1925. (243,953.)
7,263. "Meters for alternating current." Siemens Schuckertwerke Ges. March 19th, 1924. (231,167.)
8,047. "Electric jet wave commutators and interruptors." J. F. G. P. Hartmann. March 25th, 1925. (243,958.)
9,685. "Measurement of high alternating-current voltages." E. Haefely and Cie. April 16th, 1924. (Addition to 221,495.) (232,293.)
9,701. "Methods of removing coatings from conductors." British Thomson-Houston Co., Ltd. April 11th, 1924. (232,257.)
9,982. "Cables for transmitting electrical energy." L. N. Reddie (Pirelli and Co.). April 16th, 1925. (243,969.)
12,759. "Delay devices for electrical blasting fuses." W. Esbach. September 13th, 1924. (239,827.)
14,238. "Shades or deflectors for electric lamps." F. Cox. June 2nd, 1925. (243,996.)
14,422. "Incandescent electrical lamps." Neue Gluhlampen Ges. June 3rd, 1924. (235,191.)
17,137. "Electric measuring instruments." International General Electric Co., Inc. July 4th, 1924. (236,582.)
17,153. "Variable electric condensers and the like." B. Hesketh. July 3rd, 1925. (244,009.)
21,193. "Means for automatically interrupting the current in electric furnaces if a fault occurs in an electrode." Rheinische Metallwaarenund Maschinenfabrik. October 22nd, 1924. (241,865.)